THE REPERTORY OF PATENT INVENTIONS,

AND OTHER

Discoveries & Improvements

IN

ARTS, MANUFACTURES,

AND

AGRICULTURE;

BEING A CONTINUATION, ON AN ENLARGED PLAN,

OF THE

Repertory of Arts & Manufactures,

A WORK ORIGINALLY UNDERTAKEN IN THE YEAR 1794, AND STILL CARRIED ON,
WITH A VIEW TO COLLECT, RECORD, AND BRING INTO PUBLIC NOTICE,
THE USEFUL INVENTIONS OF ALL NATIONS.

NEW SERIES.—VOL. II.
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LIST

OF

SPECIFICATIONS OF PATENTS

CONTAINED

IN VOL. II. (NEW SERIES)

OF

"THE REPERTORY OF PATENT INVENTIONS."

LIST OF THE PLATES

IN

VOL. II.—NEW SERIES.

ERRATA.

Page 198, line	3 from bottom,		*for* centicular *read* lenticular.
—— 199, —	3 from top,		
—— — —	9 ———,		
—— — —	28 ———,		
—— 202, —	19 ———,		
—— 237, —	17 ———,	*for* Turreel *read* Turrell.	

THE

REPERTORY

OF

PATENT INVENTIONS.

No. VII. NEW SERIES.—JULY, 1834.

Specification of the Patent granted to PIERRE ANTOINE ANGILBERT, *of Upper Charles Street, Northampton Square, in the County of Middlesex, Gentleman, for certain Improvements in Preserving Animal and Vegetable Substances.*—Sealed June 1, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Pierre Antoine Angilbert, do hereby declare that the nature of the said improvements and the manner of carrying the same into effect, are described and set forth as follows (that is to say):

The said improvements are applicable to the preservation of animal and vegetable substances, in vessels of metal or earthenware, the apertures of which I close by certain methods, not hitherto practised in closing the vessels used for such purposes, by which methods I am enabled to make a sound and air-tight joint between the vessels and their covers, but yet the two parts can afterwards be separated readily and without using violence; whereby the contents of the said vessels may be taken

out without injuring either the vessels or the contents; and the same vessels may be used many times over, whereas with the methods at present practised of closing such vessels, violence is requisite very often to open them (unless a workman expert in soldering is at hand), by which the contents are often, and the vessels themselves almost always, injured.

My improvements consist, first, in closing the apertures of metal cases or boxes, which are used for preserving meat and vegetables therein, prepared by processes well known and in use; and, secondly, in closing the apertures of earthenware jars or vessels, which are used to preserve fruit and vegetable substances that act upon metals.

Description of the Drawing.

The figure in the engraving represents a vessel of metal adapted to be closed according to my method for preserving provisions. It is a cylindrical box, made of sheet-iron tinned; or it might be made of any other metal that will not communicate any unpleasant or prejudicial quality to the provisions preserved in it; but tinned iron is the most convenient material. The upper edge, instead of being plain for the lid to be soldered on to it in the usual way, is made with a projecting hollow rim, *a, a,* forming a channel all round it, into which the cover is adapted to fit, its lower edge, *b, b,* being turned downwards for that purpose, as shewn in the drawing. The channel, *a, a,* is intended to contain melted solder; and while the solder is in a fluid state, the cover is put on and pressed down into its place, so as to bury its lower edge in the melted solder. The solder being afterwards allowed to cool and set around the lower edge of the cover, adheres to it and to the bottom and sides of the channel, *a, a,* and thus binds them together and makes a sound joint.

The operation of enclosing provisions in one of my improved boxes, is as follows:—The iron box being first

filled with meat, or vegetable, or other provisions, which may be prepared in the way usual in the manufactories of such preservable provisions, an annular plate of thin iron, *c, c,* about an inch and a half or two inches broad, is put round it, about an inch below the rim. The plate, *c, c,* is cut in two, [see the detached plan of it,] and its ends being brought together till the plate clasps tightly round the box, are fastened together by a staple or two driven tight over them where they overlap each other. The same annular plate, *c, c,* will do for boxes or cases of various diameters. The box being now prepared, some solder is melted and poured into the channel, *a,* and red-hot coals are put on the plate, *c, c,* all round the box, and kept hot in order to keep the solder in a state of fusion while the lid *b,* is put on and pressed down, as aforesaid, into its place, to plunge its lower edge below the surface of the melted solder. If any parts of the edge do not get well covered with solder, they must be touched over with a little resin, in powder, and solder. When the joint seems to be quite covered with solder the hot coals are removed from the plate *c, c,* and the solder is allowed to cool and harden, and a sound and hard joint is thus made. The annular plate, *c, c,* may then be removed, and the iron box, being now closed with an air-tight joint, may be exposed to the heat of boiling water, to expel the air and gases therefrom, in the usual way.

Note.—A small hole is left in the cover to allow the escape of a little air from the box when the cover is put on, without which it might be difficult to fit the cover on correctly; and also to allow the air and gases evolved from the provisions during the boiling thereof, to escape; and as soon as the operation is finished that hole must be stopped up with a little solder.

To take out the preserved provisions from one of my improved air-tight metal boxes, the annular plate, *c, c,* is to be again placed round it, and hot coals placed thereon, and kept burning until their heat melts the solder or fusible

metal contained in the channel, *a, a;* the cover, *b, b,* can then be easily lifted off without injuring the box at all. The fusible metal may be left afterwards to cool in the channel, *a, a,* where it will remain ready to be heated again the next time the box is filled and closed.

In respect to the kind of solder to be used, common solder composed of a mixture of tin and lead will answer; but I find it more convenient to use a solder fusible at a very low temperature, made of a mixture of tin, lead, and bismuth, which may be rendered fusible at lower temperatures than common solder. The proportions between the component parts of the solder used, will of course be varied according to the temperature at which it is desired that it should be fusible. I have found that a solder fusible at two hundred and forty-six degrees of Fahrenheit's thermometer, and composed of four parts of tin, one of lead, and five of bismuth, will answer the purpose very well.

That part of my improvements which relates to closing the apertures of earthenware jars or vessels, so as to exclude the external air from them, in order to preserve fruits or any kind of vegetable substances that are usually preserved in such earthenware vessels, consists in a method of closing the apertures thereof by means of caoutchouc or India rubber, which material, not being acted upon by the heat of boiling water, and being perfectly impervious to air, is well fitted to be used for the purpose.

In order to apply the caoutchouc, I have the earthenware jars or vessels made with a flat rim projecting out all round the edge of the mouth, upon which rim I lay a ring of caoutchouc, cut out to fit upon the said rim (or a circular piece of India rubber, covering the mouth of the jar as well as the rim, may be used); then over the India rubber, I apply a cover made of earthenware, or else of silver, or of plated metal, which has a flat rim also projecting all round it, to fit upon the flat rim of the

jar; the cover is forced tight down upon the packing of India rubber interposed between the two rims, by means of small wedge-shaped staples, something of the form shewn in the drawing, which clasp the two rims between their prongs; and a number of these staples being driven over them, with a mallet, all round their circumference, draw them into contact with each other. The India rubber packing being thus compressed between them, excludes the air, and forms a sound joint.

Note.—When the fruit, or other vegetable substance, contained in the jar, is to be boiled after the jar is closed, it will be necessary to leave a small hole in the cover, and then a metal cover should be used, and the hole stopped up afterwards with solder. And to prevent damage to the earthenware, by hammering on the staples that draw the rims together, a ring or washer of India rubber should be put under the rim of the earthenware jar, and another on the upper side of the rim of the cover, if the cover is also of earthenware, to prevent the metal staples from being in contact with the earthenware.

And whereas the methods which I have hereinbefore described for making a close and air-tight joint, in closing the apertures of metal or earthenware vessels, constitute my improvements in preserving animal and vegetable substances, and are, to the best of my knowledge and belief, new, as applied to excluding the external air from vessels of metal or earthenware, for the purpose of preserving animal and vegetable substances therein, I hereby claim the exclusive right to the same, under the letters patent granted to me as aforesaid.—In witness whereof, &c.

Enrolled November 13, 1833.

Specification of the Patent granted to THOMAS COOK, *of Blackheath, in the County of Kent, Lieutenant in the Royal Navy, for certain Improvements in the Construction and Fitting up of Boats of various descriptions.*—Sealed April 24th, 1830.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Thomas Cook, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the drawings hereunto annexed, and the following description thereof (that is to say):

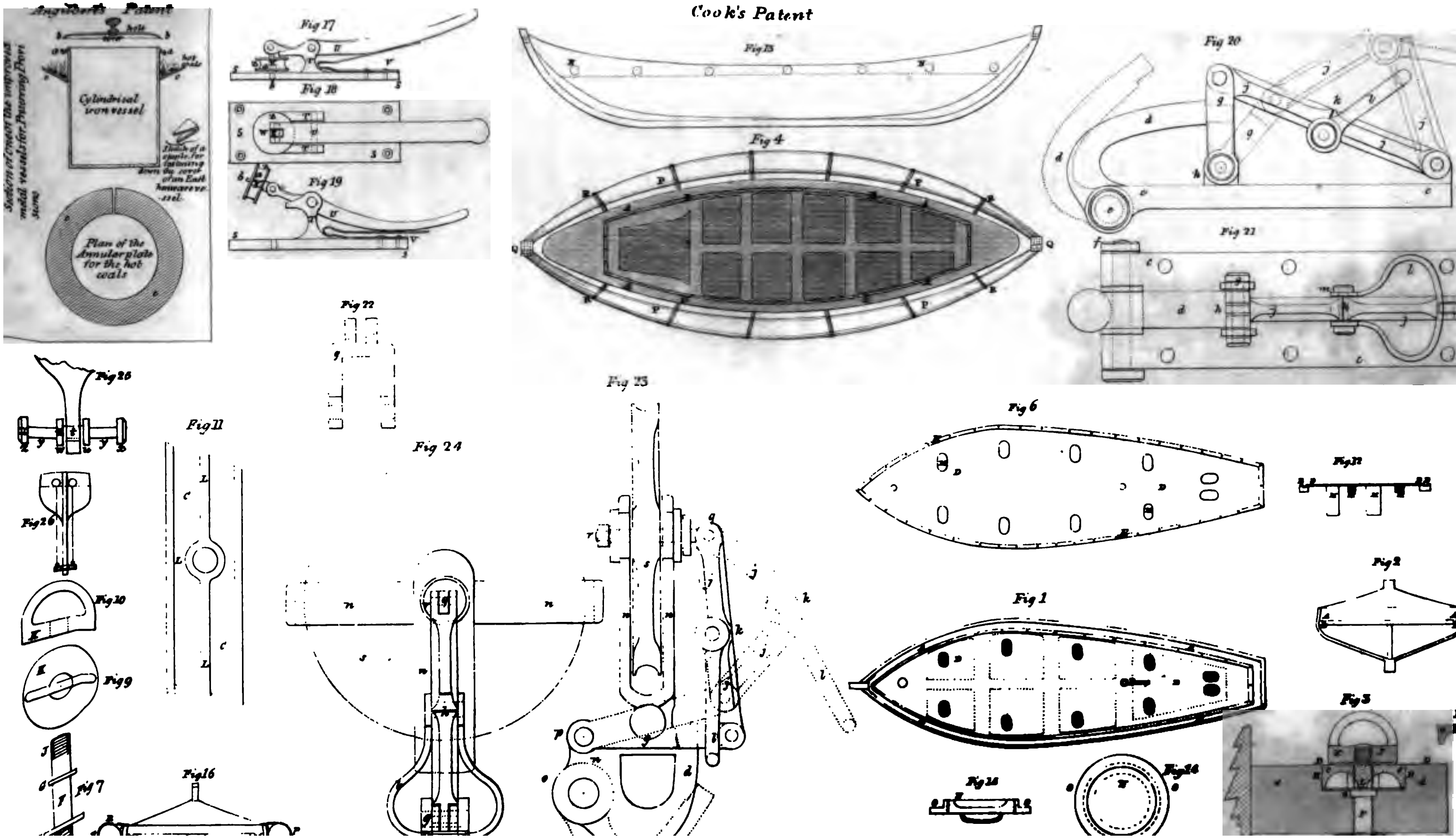
Description of the Drawing.

In the said drawing, fig. 1, is the plan of a ship's boat, or such parts of one as are necessary to be shewn; and

Fig. 2, a section taken at the broadest part of it.

The construction of this boat differs from others chiefly in having a shelf-piece, A, A, &c., formed around the inside, with a groove or channel in it, B, B.

Fig. 3, represents this shelf-piece on a larger scale. The groove or channel, B, B, figs. 2, and 3 is sunk in this shelf-piece all around it, as shewn in the plan of another boat, fig. 4; into this groove battens, C, C, &c., shewn in section in fig. 5, and made of wood or metal, are fitted, the intent of which is to secure the edges of a canvass cover, D, D, &c., which is shewn separately in fig. 6. This canvass cover is for preventing the body of water from going below the thwarts: it has a double thickness of leather, E, E, fig. 6, affixed all around its edges, to assist in making the cover water-tight; and eyelet-holes worked (shewn by dots) for hooking over the screw-bolts, F, F. The battens, C, C, &c., which may be in three, four, or more parts, are secured in the groove by means of


Cook's Patent
Fig 15
Fig 4
Fig 20
Fig 21
Fig 17
Fig 18
Fig 19
Cylindrical iron vessel
Plan of the Annular plate for the hot coals
Section of one of the improved metal vessels for Preserving Provisions
Fig 22
Fig 11
Fig 24
Fig 25
Fig 26
Fig 10
Fig 9
Fig 7
Fig 16
Fig 6
Fig 1
Fig 2
Fig 3
Fig 12

screw-bolts, F, F, &c., shewn by dots, fig. 3, and separately in fig. 7. These screw-bolts have a shoulder on each, as shewn at G, in figs. 3 and 7, which lodge in cavities made to receive them in the shelf-piece, A, and they are fastened by means of the screwed nuts, H, figs. 3 and 8, being bound upon them, a leather or metal washer, I, figs. 3 and 7, being previously interposed between the nut, H, and the under side of the shelf-piece. The upper ends of the screw-bolts, F, are likewise screwed, as shewn at J, in figs. 3 and 7; and other screwed nuts, K, K, with handles to them, are bound upon them, as shewn in fig. 3.

Fig. 9, is a top-view, and fig. 10, a side-view, of one of these nuts, shewn separately.

Fig. 11, exhibits an under-view of part of the batten, C, C, intended to shew how it is hollowed away for the sake of lightness; the middle-rib, L, L, being, however, also continued around the holes made for the screw-bolts to pass through. In the canvass cover, D, D, bags, M, M, &c., are formed to receive the legs of the boat's crew and passengers, as shewn in figs. 1, and 6; and in very large boats an opening may be left (like an inverted bag without a bottom) large enough to admit the body of a man in the after part of this cover. In the section, fig. 12, two of these bags are also shewn as drawn up, when they are not required for use. In order to allow any water which does not run off over the sides of the boats to escape, I have provided moveable metal plates, N, N, &c., which are screwed into metal screwed rings or collars, O, O, &c., with a flanch or shoulder to each ring, affixed in the sides of the boats, just above the canvass cover, as shewn in fig. 13; and any of which said metal plates may be unscrewed and removed, when necessary, to allow the water to run off, and be again replaced.

Fig. 14, is a front-view of one of these metal plates, N, and screwed rings, O, O; and fig. 15, a section thereof.

In fig. 4, P, P, &c., represent two canvass cases containing

cork cuttings or shavings, and which are laced together at the head and stern of a boat, as shewn at Q, Q, in fig. 4, holes being made for the lacings to pass through, as shewn by dotted lines in that figure, and also by dots in fig. 13. They are likewise secured by lashings, R, R, &c., which are passed through eye-bolts, or other fastenings, affixed in the sides of the boat. These canvass cases so fitted with cork and secured, form fenders, which prevent the boat from being injured in going alongside of a wreck, &c., and likewise add to its stability, and also to its buoyancy, in case of a hole being knocked through its bottom. The buoyancy, in the event of an accident of this kind would still be insured by having light air-tight cases fitted into the stem and stern of the boat above the deck in a boat like fig. 4.

Fig. 16, is a section through the boat and the two fenders, which, if preferred, may be made of air-tight bags or cases, with an outer case or covering of canvass, these might be inflated to any degree.

In order to enable the steersman to let off the boat's sheet, in case of a sudden squall coming on, I have invented the following contrivance. Fig. 17, is a side-view, and fig. 18, a plan of this boat's sheet liberator, two of them being required for each boat, one affixed to the inside of the boat's stern, on each side of the steersman. S, S, is a metal plate, with holes in it for the screws to pass through, by which it is to be secured to the inside of the boat. T, T, are ears, affixed in the plate, S, S, between which the handle or lever, U, is lodged, and turns upon a pin passed through it, and secured in the ears. V, is a bent spring, affixed at one end upon the plate, S, S, its other end acting against the longer end of the lever, U, so as to press it upwards, and consequently to depress its other end. In the shorter end of the lever, U, a gap, W, fig. 18, is made, into which is received and jointed the eye, X, which is formed at the end of an axis, Y, shewn by dotted lines in fig. 17, upon which the pulley or

sheave, *z*, is fitted and turns, and is prevented from coming off the axis, by means of a screwed nut *a*, (shewn by dotted lines) which is screwed upon the axis. The cylindrical hole or eye in the upper end of the axis, Y, fits and turns upon a cylindrical pin and passed through it, and through holes made in the sides of the gap, W, where it is firmly secured. The lower end of the axis, Y, is formed into a cylindrical pin, *b*, (shewn by dotted lines in fig. 17) which enters into a hole made in the plate, S, S, to receive it when the sheave or pulley is in use, as shewn in fig. 17; but upon the steersman depressing the longer end of the lever U, the shorter end rises, the pin, *b*, quits the hole, and the pulley, *z*, assumes the position shewn in fig. 19, at the same time letting go the sheet-line, which had been previously passed over the pulley or sheave, *z*, and the sail will then shiver in the wind.

Fig. 20, is a side-view, and fig. 21, a plan of a boat-liberator, consisting of a metal plate, *c*, *c*, with holes in it for the screwed bolts to pass through, by which it is to be affixed upon, and near to the edge of one of the charnels of a ship or other vessel, or in such other place as the standing part of a boat's gripes is usually fitted or led to: *d*, a metal hook, turning upon a pin at *e*, which is passed through cheeks formed at one end of the plate, *c*, *c*, and is secured by a screw-nut, *f*, fig. 21. The moveable or outer end of this hook, *d*, rests upon a stud affixed on the plate *c*, *c*, when it is closed, as is shewn in fig. 20, and it is prevented from opening by being lodged within a moveable cleft or forked piece of metal, *g*, which is shewn separately and endways in fig. 22. This forked piece, *g*, is jointed to the plate, *c*, *c*, at *h*, and at the upper end of it a compound bar, *j*, *j*, is also jointed at one end of it, the other end of the said compound bar being jointed to the end of the plate *c*, *c*. This compound bar, *j*, *j*, has a rule-joint in its centre, as shewn at *k*, in figs. 20, and 21; and there is also connected with this

rule-joint the handle, *l*, by means of a screwed pin being passed through holes made in the several parts to receive it, and it is finally secured therein by means of a screwed nut, *m*, fig. 21. When the compound bar, *j*, *j*, is in the position shewn in fig. 20, or in a straight line, it effectually prevents the forked piece, *g*, from moving, and consequently the hook, *d*, when lodged within it; but upon pulling the handle, *l*, outwardly, the jointed bar, *j*, *j*, becomes bent, as shewn by the dotted lines, and pulls the forked piece, *g*, into the position, likewise shewn by the dotted lines, and the hook, *d*, is then at liberty to open, as is likewise shewn by the dotted lines in fig. 20. The boat being secured by a gripe, the bight of which having a thimble seized in it, is hung upon the hook, *d*; whilst its two ends are led under and over the boat, and secured in the usual way, by lanyards, to the inside of the vessel. Upon releasing the hook, *d*, by pulling the handle, *l*, the boat is instantly liberated without casting off the lanyards. I can also apply the hook, *d*, to the frame of a pulley-block or sheave, whether single, double, or treble, in the manner shewn in fig. 23, which is a side-view, and in fig. 24, which is a front view of it. *n*, *n*, &c., represent the metal frame of the pulley-block. *d*, the hook, which is jointed to the frame, *n*, *n*, at *o*, fig. 23, its outer end, which rests when closed upon the side of the frame, being retained in that situation by a forked piece, *g*, which is jointed to the frame at *p*, fig. 23, and has a compound bar, *j*, *j*, jointed to its outer end, and like that described in the references to figs. 20, and 21, having a rule-joint, *k*, in its centre, its other end being jointed at *q*, to the centre-pin, *r*, of the pulley, *s*; and there is also a handle, *l*, connected with the rule-joint *k*, by pulling which the hook, *d*, will be released, in a similar manner to that above described, the situations of the different parts being shewn by the dotted lines in fig. 23. The use of this improved block is principally to detach in an instant a boat from the tackle-falls, either before or when

she touches the water in lowering, whilst the ship or other vessel has way through the water, or when a heavy sea is running.

In addition to the usual ways of ballasting boats, I have contrived the following. I pass a screwed bolt, *t*, fig. 24, through the fore-part of the keel of the boat, the bolt having a shoulder, *u*, formed upon it, and a screw at *v*, to receive a screwed nut, *w*, by binding which fast the bolt will be securely affixed in the keel. A head, *x*, is formed at one end of this bolt, leaving a neck, *y*, between it and the shoulder, *u;* and a screwed nut, *z*, is affixed upon the other end of the bolt, *t*, leaving a similar neck, *y*, between it and the other screwed nut, *w*. Upon each of these two necks, *y*, *y*, I lodge or rest one end of a bar of iron, having a gap formed in it to lodge upon the neck of the bolt, and as shewn in fig. 25. The other ends of these two iron bars being secured alongside of the keel, by proper keepers, and being also suspended by chains or rods, leading to or through holes made in the stern of the boat. In case of the boat being stove, these rods or iron ballast may be instantly detached from the boat by letting go the chains or rods, when they will, of course, fall perpendicularly into the water, leaving the boat as much lighter as the weight of the ballast amounted to.

Fig. 26, shews the stern of a boat, and the ends of the two iron bars (shewn by dotted lines through the keepers) as suspended by the chains or rods above described. A life-line may also be rove through all the rings or handles of the nuts, *k*, *k*.

I do not mean or intend hereby to claim as my invention, any of the various parts herein shewn and described, which may already be known or in use, excepting when they are applied to the construction and fitting up of boats of various descriptions; neither do I mean or intend hereby to limit myself to the particular forms or shapes herein shewn, nor to the use of those materials only which are herein mentioned, but to avail myself of

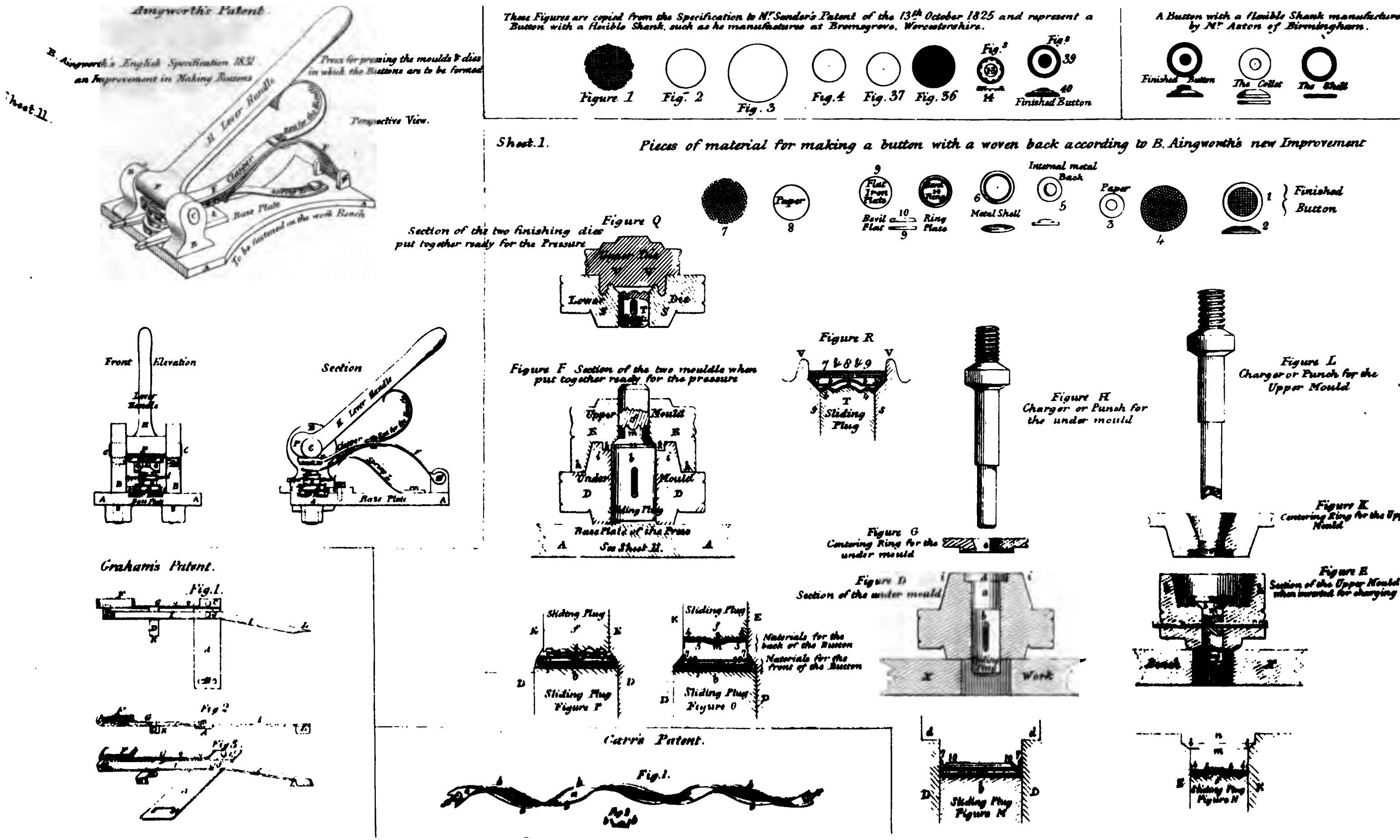
all which are fit and proper for the several purposes mentioned herein. I do, however, hereby claim as my invention, and the objects of this patent, the mode of affixing the canvass cover, and thereby nearly excluding the water from entering the body of the boat underneath the thwarts and canvass cover; likewise the method of letting off the water through the holes made in the boat's sides and stern for that purpose, and the closing of those holes by means of the screwed metal plates; likewise the mode of applying the two fenders to the outside of the boat's gunwale; and also the mode of applying and detaching the iron bars forming the ballast of the boat; I likewise hereby claim the mode of letting go the bight of the boat's sheet or sail, as described in the references to figs. 17, 18, and 19; and also the liberator for detaching the boat from the gripes, described in the references to figs. 20, 21, and 22; and, lastly, the method of securing and letting go the hooks of tackle-fall blocks, described in the references to figs. 23 and 24.—In witness whereof, &c.

Enrolled June 22, 1830.

Specification of the Patent granted to Riley Carr, *of Sheffield, in the County of York, Manufacturer, for certain Improvements in Machinery for Cutting, Cropping, and Dressing Woollen and Cotton Cloths.*— Sealed December 11, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.— *Now know ye*, that in compliance with the said proviso, I, the said Riley Carr, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):



Aingworth's Patent.
B. Aingworth's English Specification 1831 an Improvement in Making Buttons
Press for pressing the moulds & dies in which the Buttons are to be formed
Perspective View.
Sheet II.
Front Elevation
Section
Base Plate
Graham's Patent.
Fig. 1.
Fig. 2
Fig. 3
These Figures are copied from the Specification to Mr. Sander's Patent of the 13th October 1825 and represent a Button with a flexible Shank, such as he manufactures at Bromsgrove, Worcestershire.
Figure 1
Fig. 2
Fig. 3
Fig. 4
Fig. 37
Fig. 36
Fig. 39
40 Finished Button
A Button with a flexible Shank manufactured by Mr. Aston of Birmingham.
Finished Button
The Collet
The Shell
Sheet. 1.
Pieces of material for making a button with a woven back according to B. Aingworth's new Improvement
Paper
Flat Iron Plate
Bevil Flat
Ring Plate
Metal Shell
Internal metal Back
Finished Button
Figure Q
Section of the two finishing dies put together ready for the Pressure
Upper Die
Lower Die
Figure R
Sliding Plug
Figure H
Charger or Punch for the under mould
Figure L
Charger or Punch for the Upper Mould
Figure F Section of the two moulds when put together ready for the pressure
Upper Mould
Under Mould
Sliding Plug
Base Plate of the Press
See Sheet II.
Figure G
Centering Ring for the under mould
Figure K
Centering Ring for the Upper Mould
Figure D
Section of the under mould
Work
Figure E
Section of the Upper Mould when inverted for charging
Bench
Sliding Plug
Sliding Plug Figure P
Sliding Plug Figure O
Materials for the back of the Button
Materials for the front of the Button
Sliding Plug Figure M
Sliding Plug Figure N
Carr's Patent.
Fig. 1.

My invention relates to an improved construction of the spiral blades used in cutting, cropping, and dressing the pile of woollen and cotton cloths; and my improvements consist in turning up the two edge of a plate of metal (of a suitable length and breadth for the blades) and thus forming two cutting blades, standing at an angle to the base or part of the metal plate, which is affixed on to the roller or cylinder of the shearing-machine, by which means the spiral blades will be held more firmly, truly, and securely on the cylinder or roller, than can be obtained with single spiral blades, as will be fully described.

Description of the Drawing.

Fig. 1, shews two spiral blades complete and ready to be placed on the roller or cylinder of a shearing machine.

Fig. 2, is a transverse section thereof, by which it will be seen the whole is formed from one plate of metal.

In each of these figures, the same letters refer to the same parts; and I would remark, that I have not thought it necessary to shew a shearing-machine, that machine being well understood. My invention relating only to the spiral blades, it will only be necessary to describe the manner of constructing them, the manner of working or using them being similar to single spiral blades.

a, a, represent the part of the plate which winds round the cylinder or roller; and *b, b,* are the two edges, which are turned up and form the double spiral blade. It will be evident that by constructing two blades in the manner here shewn, from one plate of metal. The space between the blades acts as a stay, and materially tends to strengthen the bearing of the two blades on the roller or cylinder of the shearing-machine.

In constructing these double spiral blades, I usually take a plate of rolled steel, or of rolled iron and steel welded together, the iron being in the centre, of the thickness usually employed for spiral blades, and by

forging, or otherwise, turning up the two edges to form the two blades, *b, b,* I then wind the plate, so turned up at its edges, on to a true roller or cylinder, of ten or twelve inches diameter; and after this they are removed from the rollers and drawn out in a winding or spiral direction, either of a right or left twist, in like manner to that pursued in forming single blades, by which means the desired spiral figure is given the double blades; they are then hardened by heating red hot in a furnace and immersed in oil or water, and are afterwards ground and set in like manner to single spiral blades; and these double blades are made fast to the cylinder or roller of the shearing-machine, by screws and nuts, *c,* attached to the ends, as is well understood.

Having now described the nature of my invention, and the manner of performing the same, I would have it understood that I do not confine myself to using a plate composed wholly of rolled steel, though I prefer that metal, for it will be evident that iron or other metal may have steel edges welded or brazed thereto, and thus produce double blades from one plate. And I do hereby declare that my improvements consist in forming or constructing two blades, by turning up the edges of a plate of metal, as above described, when used in machinery for cutting, cropping, and dressing woollen and cotton cloths.—In witness whereof, &c.

Enrolled June 11, 1834.

Specification of the Patent granted to WILLIAM GRAHAM, *Jun., of the City of Glasgow, Cotton Spinner and Power-Loom Manufacturer, for a Self-acting Temple, to be used in the operation of Weaving by Power or Hand-Looms.*—Sealed May 22, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—

Now know ye, that in compliance with the said proviso, I, the said William Graham, do hereby declare the nature of the said invention, and the manner in which the same is to be performed, are fully described and ascertained, in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

The invention consists in apparatus affixed near each end of breast-beam, which, being acted on by the swinging of the lay in beating up the weft, are caused to open and shut, as will be fully described hereafter, and by means of these apparatus the cloth is held to the width at which the reed leaves it after having beaten up the weft. In order that the invention may be fully described and understood, I will proceed to describe the drawing hereunto annexed, first observing that the same letters of reference indicate similar parts in each of the figures.

Description of the Drawing.

Fig. 1, is a plan of one of the self-acting temples.

Fig. 2, is a front edge-view; and

Fig. 3, a perspective view thereof. A, is a plate which is affixed to the breast-beam of the loom at the slit or gap, B, by means of a screw-bolt passing through the breast-beam; and where different widths of fabric are woven in the same loom, the temples must be so constructed as to allow of their being brought nearer to or recede farther from each other, by means of the slits, B, formed in the plate, A. On to the plate, A, is fixed, by means of a screw, another plate, C, having a projection, D, which is turned down at right angles at E, the object of which will be hereafter described. The outer end of the plate, C, is turned over, so as to produce a parallel plate, F, leaving a space between them. G, is a spring affixed to the plate, C, by rivetting or otherwise, and on the part, H, of the face of this spring, is formed teeth or grooves, cut in a line with the direction of the cloth, these teeth

or grooves being intended to hold the cloth when the spring is pressing upwards against the plate, F. I, is a lever, which has its fulcrum at J, on the plate, A; and at one end of the lever, I, is formed a projecting wedge, K, which is pressed between the upper plate, F, and the spring, G, every time the lay beats up the weft, by the lay coming in contact with the other end, L, of the lever, I, this end, L, being turned down, as shewn in the drawing, for that purpose.

Having described the manner of construsting the apparatus which constitutes the self-acting lay, I will now describe the manner of working, first observing that there is to be one of the apparatus placed near each end of the breast-beam that is in such position that they shall just embrace the outer edges or selvages of the fabric, between the plate, F, and the spring, G, and they are so placed as to take hold of the fabric, as near as possible to the point at which the reed strikes up the weft, but the reed is prevented being injured by the bottom of the lay coming in contact with the parts, E, which stops the lay from approaching too near to the temples at the time of beating up the weft, and at the time the lay has nearly finished its stroke it comes against the part, L, of the lever, I, which drives the wedges, K, between the plates, F, and the springs, G, and causes them to separate to permit of the fabric being drawn through them, but immediately on the receding of the lay, after having beaten up the weft, the springs, G, will press up against the plates, F, and retain the cloth between them, the wedges, K, being forced out by the pressing up of the springs, and by this means the fabric will be kept to the width at which the reed leaves it.

I have not thought it necessary to shew a loom of any of the various constructions, which are well known, the invention only relating to the parts described, which any competent mechanist will readily construct and apply. And I would have it understood, that, what I claim as

the invention communicated to me, is the apparatus. above described when applied to power or hand looms for the purpose of keeping the fabric to the width at which the reed leaves it.—In witness whereof, &c.

Enrolled November 18, 1833.

Specification of the Patent granted to BENJAMIN AINGWORTH, *of Birmingham, in the County of Warwick, Button Maker, for an Improvement in the Making and Constructing of Buttons.*—Sealed August 30, 1832.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Benjamin Aingworth, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are described and ascertained in manner following (that is to say):

My invention of an improvement in the making and constructing of buttons consists in affixing (by a particular mode hereinafter described) to that side of the button which is to go against the garment whereon the button is to be worn (and which side is usually called the back of the button) a strong covering composed of threads of silk, flax, or worsted, or other suitable material, woven into a tissue or cloth, which covering I call a woven back, and which woven back, when sewn (by a needle and thread) to the garment will serve in lieu of a shank to fasten the button thereto. And whereas buttons with woven cloth fastened to them at their backs, to serve as substitutes for shanks are extensively manufactured by Mr. Benjamin Sanders, at Bromsgrove, in Worcestershire, according to a patent granted to him by his late Majesty, and bearing date the 13th day of October, 1825, and which buttons are known in the trade by

the name of Flexible Shank Buttons, it is necessary that I should point out the circumstance which constitutes the novelty and utility of my improvement, and wherein the same differs from the previous invention of Mr. Sanders, and also from certain buttons which have been made in imitation thereof, by Mr. Aston of Birmingham.

Description of the Drawing.

Section A, in sheet 1, of the drawings hereunto annexed, contains a representation of the kind of button manufactured by Mr. Sanders; the figures therein being copied from the drawings annexed to his specification, which was enrolled in consequence of his said patent (viz.) fig. 39, is a view of the back of the said button, and fig. 40, a view of the same button edgeways; both those figures representing the button as it appears in its finished state. At the back of the button, fig. 39, and 40, is a circular ring of metal called a collet, which extends around the centre of the back of the button, in order to fasten the several parts thereof together, and the woven cloth, which forms the flexible shank is puffed up into a prominent tuft, which rises up through the central hole of that ring or collet of metal. It is the said central prominent tuft of woven cloth which is sewn (by a needle and thread) to the garment whereon the button is to be worn.

Section B, in sheet 1, of the drawings hereunto annexed, represents a back-view and an edge-view of a button manufactured by Mr. Aston, as aforesaid; it has a metal collet at the back around the centre, presenting nearly the same external apppearance as the collet in Mr. Sanders' button in section A, except that the collet at the back of Mr. Aston's button is broader and larger, so as to extend nearer toward the outer circumference of the button.

Buttons made according to my said improvement are represented at 1 and 2 of the small figures in sheet 1:

there is no metal collet at the back, but the woven back extends over all the central part of the back of the button, and reaches towards the circumference thereof. When the button is affixed to the garment by sewing the middle part of the woven back to the garment (with a needle and thread), the whole button will lay close to the garment so as to have a neat appearance, and when the garment is buttoned the back of the button which then comes in contact with the front sides of the button hole, being clothed with a smooth and soft woven surface will not have so much tendency to wear the sides of the button hole as the convex surface of metal which is presented to the sides of the button hole by the metal collets at the backs of the flexible shank buttons manufactured as aforesaid by Mr. Sanders and by Mr. Aston, and which buttons are represented in section A, and section B, of the drawing, sheet 1.

The woven back for a button made according to my improvement, may be cut out in a circular piece, 4, rather larger than the intended button, from a piece of suitable strongly woven tissue or cloth.

Note.—The circular piece, 4, is of itself nearly the same as the corresponding piece (see fig. 36, section A,) which is to form the flexible shank in Mr. Sanders and Mr. Aston's buttons; but instead of the external collet of metal (see figs. 13 and 14, section A, or the collet shewn in section B,) which they use to fasten the said piece of woven cloth in its place at the back of the button, I employ a circular plate, or blank of metal, 5, which I call the internal metal back, and which is less than the button, and it does not require any hole through it, but it may, if required, have a small depression sunk in the centre.

The internal metal back, 5, when in its place, occupies the interior of the finished button, 1, 2, behind the woven back, 4, and forms a part of the kernel of the button, which kernal gives firmness and stability thereto.

Note.—One or more circular pieces of paper, 3, of nearly the same size as the metal back, 5, (and which pieces of paper may be perforated with a central hole, if required,) must be interposed between the metal back and the woved back, 4, in order to give some prominence to the woven back; and note—if the paper, 3, is perforated with a central hole, the woven back may have a depression at the centre.

The circumference of the woven back, 4, is turned over the circular edge of the internal metal back, 5, all around the same, so as to wrap up and inclose the internal metal back, 5, together with the papers, 3, within the woven back, 4, in such a manner that the said woven back cannot be separated from the button without carrying away the internal metal back, 5, with it, or else tearing the material of which the woven back, 4, is composed.

The woven back, 4, is fastened in its place at the back of the button by an attachment which is made all around the outer circumference of the back of the button, which back is composed, as aforesaid, of the woven back, 4, with the internal metal back, 5, and the papers, 3, wrapped up within it. The said fastening or attachment, is made by the aforesaid outer circumference being over-lapped by the raised edge of a metal shell, 6, which shell may be covered on the face or front with any suitable material, according to the appearance that the face of the button is required to exhibit. The covering will most commonly be a woven tissue of stuff, or cloth of woollen or worsted, or silk; but leather may be used for covering the face or front of the shell, 6, and one or more pieces of paper, 8, may be interposed between the shell, 6, and the covering. The shell, 6, together with the internal metal back, 5, and the papers, 3 and 8, (if such are used) constitutes the kernal, which gives stability and form to the button. The metal shell, 6, is very similar in form to the shells which are commonly used for what are called shell-buttons, and is very similar

to the shells used by Mr. Aston, in flexible shank buttons, see section B, viz. the edge of a circular plate of thin metal is raised up all round to form a hollow dish or shell, 6, for the reception of the woven back, 4, when the internal metal back, 5, and the papers, 3, are wrapped up within it.

Note.—The only difference between the metal shell, 6, and that used by Mr. Aston, is, that the metal shell, 6, is gathered in at the top edge to a smaller size than the flat bottom of the shell, so as to form a conical or bevil rim to the dish.

A circular piece, 7, of the material, wherewith the front face of the button is to be covered, is cut out larger than the button, and extended over the front face of the metal shell, 6, as an outside covering thereto; and a circular piece of paper, 8, may be interposed between the covering, 7, and the metal shell, 6. The circumference of the covering, 7, and of the paper, 8, (if any is used) is to be turned over the circumference of the metal shell, 6, all around, so as to wrap up and enclose the whole of the front face, and also the raised edge of the shell within the covering, 7, which covering will overlap so far beyond that raised edge as to extend into the hollow of the shell, 6.

The back of the button is composed, as aforesaid, of the woven back, 4, with the internal metal back, 5, and the papers, 3, enclosed and wrapped up within the woven back, 4, in order to give form and stability thereto. The compound back thus formed is inserted into the hollow of the shell, 6, in such manner that the overlapping edge of the woven back, 4, where the same turns over around the edge or circumference of the internal metal back, 5, as well as the overlapping edge of the front covering, 7, where the same reaches over the raised edge of the shell, 6, and extends into the hollow thereof, will be included and concealed within the interior thickness of the button; and, in order to fasten all the afore-

said parts of the button firmly together in their respective places, the raised edge of the metal shell, 6, (which raised edge is overlapped as aforesaid within the front covering, 7,) is pressed down, or turned inwards, over the edge of the internal metal back, 5, (which edge is enveloped within the woven back, 4,) so as to overlap and confine the back in its proper place, by an attachment all around its circumference; and the same overlapping confines the woven back, 4, as well as the front covering, 7, from separating from the button.

Note.—Instead of the aforesaid raised edge of the shell, 6, being formed out of one continuous piece of metal, with the flat surface of that shell, I rather prefer to use a flat circular blank of metal plate, 9, together with a narrow ring, 10, in lieu of the shell, 6.

The ring, 10, is formed on a bevil, the same in size and shape as the raised edge of the metal shell, 6, viz. it resembles a portion of the base of a hollow cone. The bevil ring, 10, is applied upon the circumference of the flat plate, 9, so that the bevil ring, 10, and flat plate, 9, when put together, will have the same form of a hollow dish, as the shell, 6, which is formed out of one piece of metal by wrapping up the said blank, 9, and ring, 10, both together, within the front covering, 7; the said blank and the ring are retained together, and the edge of the covering, 7, overlaps beyond the edge of the ring, 10, into the hollow thereof, in the same manner as it would overlap into the hollow of the shell, 6.

The fastening together of the back and front of the button is the same as hereinbefore described, whether it is made with the blank, 9, and bevil ring, 10, or with the shell, 6.

Note.—The pressure, whereby the front and back parts of the button are joined together, should be made to indent the centre of the woven back, 4, as well as of the papers, 3, which are placed behind it by forcing the same into the indentation at the centre of the metal back,

5, or if the said papers, 3, are perforated at the centre the perforation will facilitate the said indentation. The said pressure should leave a permanent indentation at the centre of the woven back of the finished button, 1, in order to serve as a guide for the insertion of the needle, when the back of the button is to be sewn to the garment.

The distinctive character of buttons made according to my said improvement, is, that the woven back, which serves as a substitute for a shank, is extended and supported and affixed in its place at the back of the button, by means of an internal metal back, which is applied within or behind that woven back, so as to be wrapped up within the said woven back, and thereby entirely concealed within the thickness of the button; and by virtue of my said improvement, I avoid the use of any external metal collet, or ring, for the purpose of fastening the woven back in its place: whereas in the buttons heretofore manufactured under the name of flexible shank buttons, by Mr. Sanders, and by Mr. Aston, as aforesaid, it has been necessary to apply a collet or ring of metal, which is fastened externally over the outward part of the cloth at the back of the button, in order to retain and fasten that cloth from separating from the button.

And respecting the tools or implements, whereby buttons may be made with woven backs, as represented at 1 and 2, according to my said improvement, as hereinbefore set forth:—the principal implements are hollow cylindrical moulds, of a size suited to that of the intended button, into which moulds the several circular pieces of woven cloth, and paper, and metal, which are to be performed into a button of the kind hereinbefore described, and represented at 1 and 2, or introduced or charged; and by ramming the said pieces down into the moulds, the circumferences of the pieces of woven cloth and paper are turned up all around the circumference of the circular pieces of metal; one part of the mould, which I call the under-mould, is thus charged with those

pieces of materials, which are to form the front of the said button. The other part of the mould, which I call the upper-mould, is charged with those pieces of materials which are to form the back of the said button. By putting the upper and under moulds together, after each one has been so charged with its proper share of the materials, and by pressing up a movable sliding plug, which is fitted into the under mould, the several pieces of materials which are to constitute the front of the button, are raised up out of the cavity of the under-mould into the cavity of the upper mould, and are brought in contact with those pieces of materials which are to constitute the back of the button; and then by pressing downwards upon a sliding plug, which is fitted into the upper-mould, the materials for the back of the button are inserted into the hollow within the materials for the front thereof, so as to combine all the parts of the button together, in the relative positions hereinbefore described, but without finally fastening those parts together. The moulds are then separated, and by touching the sliding plug of the upper-mould, the imperfect button is pushed out therefrom, and is afterwards transferred to another pair of moulds, wherein the button is submitted to a strong pressure, which by pressing down the raised edge of the metal shell, 6, (or else the edge of the bevil ring, 10, when that is used in lieu of 6,) clenches and fastens all the parts of the button firmly together, and gives the proper form and stability to the button; sections of the said under and upper moulds when separated are represented in figs. D, and E, and a section of both when put together in fig. F.

The moulds are made of cast steel turned truly circular in a lathe and hardened. The under mould fig. D, is that wherein the materials for forming the front of a button are to be charged or brought together and moulded into the required shape in preparation for joining them to the other materials which are to form the back of the button.

In the centre of the under-mould, D, is a cylindrical hole, *a*, of the same diameter as the intended button, and a moveable plug, *b*, of cast steel, is fitted truly therein, so as to slide freely up and down, the extent of its motion being limitted by a cross-pin, *c*, which is put through the mould from side to side, and which pin passes through an oblong slit in the sliding-plug, *b*. When the sliding-plug, *b*, is pressed down as low as the cross-pin, *c*, will permit it to descend, the lower end of the plug, *b*, protrudes below the bottom of the mould, as shewn in fig. D; and the upper end of the plug, *b*, leaves a cylindrical cavity, *a*, above it in the mould, for the reception of the stuff covering, 7, together with the metal shell, 6, (or else the metal blank, 9, and ring, 10, in lieu of the shell, 6,) which pieces are to constitute the front of the intended button, as before stated. When the mould is to be charged with those materials, it is placed over a hole in the work-bench, X, which will allow the end of the sliding-plug, *b*, to protrude beneath the under-side of the mould, as is shewn in figs. D, and E; and in order that the said pieces of materials may be introduced into the cavity, *a*, of the mould, exactly concentrically therewith, a rebated groove, *d*, is excavated around the top part of the mould of a true size to receive the circular piece of front covering, 7, which is lodged therein, and then a circular ring, fig. G, which I call a centering ring, is placed over the piece of covering, 7, in the circular rebate, *d*, the centering-ring, G, having a circular rim at the under-side to fit into the rebate, *d*. And,

Note.—If a circular piece of paper, 8, is required to be interposed as a lining behind the covering, 7; then a rebate groove, *e*, must be excavated at the under-side of the centering-ring, G, of a true size, to receive the said piece of paper, 8, which paper is rather less than the piece of covering, 7. The piece of paper, 8, is lodged in its rebate, *e*, at the under-side of the centering-ring, G, and it must fit therein, so that it will not fall out by its

own weight, when the centering, G, is turned over and dropped into its rebated groove, *d*, at the top of the mould.

By thus placing the centering-ring, G, in its rebate, *d*, the paper, 8, is brought in contact with the covering, 7, and exactly concentric therewith; and both 7 and 8, will be concentric with the hollow, *a*, of the mould, over the mouth of which both 7 and 8, are placed. The interior of the centering-ring, G, is of a proper size to receive the outside of the metal shell, 6, (or else of the blank, 9, and the bevil-ring, 10, which may be used together in lieu of the shell, 6, as before explained.) The centering-ring, G, being in its place over the mould, and the shell, 6, (or else the blank, 9, and the bevil-ring, 10, in lieu of 6,) being dropped into the centering-ring, G, they will come in contact with the paper, 8; or if that paper is omitted, the metal will come in contact with the covering, 7, and be concentric therewith, and with the hollow, *a*, of the mould which is beneath. The several pieces of material (viz.) the covering, 7, and paper, 8, and metal, 6, (or else 9 and 10, in lieu of 6,) being thus lodged one above another over the mouth of the mould, they are all forced down together to the bottom of the cylindrical cavity, *a*, of the mould, by a cylindrical charger or punch, fig. H, which is pushed down through the centering-ring, G, by pressure of the hand. The end of the charger or punch, H, is formed with a slight rebate or groove round it to fit to the inside of the raised edge of the shell, 6, (or of the bevil ring, 10, if it is used in lieu of 6,) and the flat end of the charger or punch, H, entering into the hollow of the shell (or of the bevil-ring, 10,) applies to the flat bottom of the shell, 6, (or to the flat metal blank, 9,) in order to avoid crushing down the said raised edge of the shell, 6, (or of the bevil-ring, 10,) by the force wherewith the charger or punch, H, is pushed down. The said action of forcing down the charger or punch, H, into the under-mould, D, causes the circumference of the covering, 7, (and of the

paper, 8, if such a paper is used), to turn up all around the raised edge of the shell, 6, (or of the bevil-ring, 10,) so that the said circumference will stand up all around against the cylindrical inside, *a*, of the mould, in the space which is left in the mould around the cylindrical charger or punch, H, when the same is forced down into the mould. The charger or punch, H, is then withdrawn, and the centering-ring, G, removed, leaving all the circular pieces aforesaid, at the bottom of the mould, and the position that they occupy therein is explained by fig. M, which is a section of them, drawn twice their real size. The charging of the under-mould, D, with those circular pieces of materials which are to constitute the front of the button is now completed.

Fig. E, is a section of the upper-mould, wherein the materials for the back of the button are to be charged, and moulded into the required shape for preparing them to be joined to the materials for the front of the button, which have been charged, as aforesaid, into the under-mould. The upper-mould, E, is represented in an inverted position in fig. E; it has a moveable sliding-plug, *f*, fitted into a cylindrical cavity, *m*, which is perforated through the centre of the mould, in a similar manner to the sliding-plug, *b*, of the under-mould, except that the sliding-plug, *f*, is of a smaller size than the intended button, being only so much larger than the internal metallic back, 5, as to allow for the thickness of the woven back, 4, all around the circular edge of the metallic back, 5. The motion of the sliding-plug, *f*, is limited by a cross-pin, *g*, and the end of the sliding-plug, *f*, is suitably formed to give the indentation which is required at the centre of the woven back, 4. The upper-mould is hollowed out at *h*, *h*, to a counterpart in form and size to the exterior, *i*, *i*, of the under-mould; and when the upper-mould is applied upon the under-mould, as is represented in fig. F, the two moulds fit exactly together and form as it were one piece. A pro-

minent interior rim, *k, k,* within the upper-mould, fills the circular rebate, *d,* which is excavated around the mouth of the under-mould, and the cylindrical cavity, *a,* in the interior of the under-mould, is carried a little way up into the upper-mould, at *n,* exactly of the same size as the intended button, being a continuation of the cylindrical cavity, *a,* into which the sliding-plug, *b,* of the under-mould, is fitted. The interior cavity of the upper-mould then diminishes in size from *n,* with a hollow domed form at *l, l,* which brings it to size of the cylindrical cavity, *m,* into which the sliding-plug, *f,* of the upper-mould is fitted.

In order to charge the materials for forming the back of the button into interior cylindrical cavity, *m,* of the upper-mould, E, it is placed in an inverted position over a hole in the work-bench, X, as is shewn in fig. E, and a centering-ring, fig. K, is to be applied over the mouth of the mould. A circular rebate, O, is excavated at the under-side of the centering-ring, K, of a proper size to receive the circular piece, 4, which is to form the woven back, and which piece must fit into the rebate, O, so that it will not fall out by its own weight when the centering-ring, K, is turned over and dropped over the upper-mould, E, in order to convey the said woven back, 4, over the mouth of the mould, and concentric therewith. The interior of the centering-ring, K, is the exact size of the metal back, 5. One or more of the circular pieces of paper, 3, are dropped into the interior of the centering-ring, K, upon the woven back, 4, and then the metal back, 5, is dropped in after them. The several pieces of materials for the back of the button being thus laid over the mouth of the mould, and truly concentric with the interior thereof, the charger or punch, fig. L, is inserted through the centering-ring, K, into which it fits, and being pressed down by hand it carries down the metal back, 5, and the papers, 3, and the woven back, 4, all together into the cylindrical cavity, *m,* within the upper-

mould, wherein the sliding-plug, *f*, is fitted, that plug retreating before the pressure as far as the cross-pin, *g*, will permit it to go. The action of thus ramming down the materials causing the circumference of the woven back, 4, to turn up all around the circumference of the metal back, 5, and of the papers, 3, so as to stand up around the inside of the cylindrical cavity, *m*, of the mould, in the space which is left in that cavity around the charger or punch, L. The charger or punch, L, is then withdrawn, and the centering-ring, K, removed, leaving all the circular pieces aforesaid at the bottom of the mould. The position they occupy therein, is explained by fig. N, which is a section of them drawn twice the real size. The charging of the upper-mould with those circular pieces which are to constitute the back of the button is now completed.

The two moulds being charged separately, in the manner above described, each one with its own share of the materials for making a button, the moulds are taken up from the bench, X, on which they rested whilst they were charged, and the two moulds are put together by turning the upper mould, E, over, and placing it on the top of the under-mould, D, in the manner shewn in the section, fig. F; and when that is done, the lower end of the sliding-plug, *b*, is pushed upwards by the finger, whilst the two moulds are firmly grasped together in the fingers; by that means the materials for the front of the button, which are contained in the cavity, *a*, of the under-mould, are raised up out therefrom, and transferred into the cavity at *n*, *l*, *l*, within the upper-mould, whereby they are brought nearly in contact with the materials for the back of the button, which are contained in the cavity, *m*, of the upper-mould. The pair of moulds are then submitted to pressure in a press, shewn in sheet II., into which they are placed, with the lower end of the sliding-plug, *b*, resting upon the solid bottom of the press. The press, when brought into action on the pair of moulds,

first exerts a moderate pressure upon the top-surface of the upper-mould, E, before it causes any pressure on the top of the sliding-plug, *f*, of the upper-mould. The effect of that first pressure is to complete the action which was commenced by raising the sliding-plug, *b*, with the finger, as aforesaid, that is to say, the circumference of the front covering, 7, (and of the paper, 8, if any such is used), which stood up in a cylindrical form, like a lining to the interior cylindrical cavity, *a*, of the under-mould (see fig. M,) is forcibly pressed by the dome-shaped contraction, *l*, *l*, of the cavity of the upper-mould, and thereby the circumference of the front-covering, 7, (and paper, 8, if any such is used,) is turned over the bevil-edge of the shell, 6, (or else the edge of the bevil-ring, 10, if used in lieu of 6,) in the manner represented by the section, fig. O. The materials for the back of the button remaining all the while within the cylindrical cavity, *m*, of the upper-mould, and nearly, but not quite, in contact with the materials for the front of the button. The press, after having exerted the said moderate pressure upon the upper-mould, E, and produced the effect above described, then causes a forcible pressure upon the top of the sliding-plug, *f*, of the upper-mould, and thereby the materials for the back of the button are forcibly driven down upon the materials for the front thereof, so as to turn the overlapping edges of the front-covering, 7, and those of the woven back, 4, both together into the hollow within the shell, 6, (or of the bevil-ring, 10, which may be used in lieu of 6,) in the manner represented by the section, fig. P. The materials for the whole button being thus put together in their relative positions, the moulds are removed from the press and separated, the newly-formed button will remain in the upper-mould, until it is pushed out therefrom, by applying the finger to the sliding-plug, *f*; and it is then put between a pair of finishing-dies, fig. Q, and again submitted to pressure in the same press, sheet II.

The finishing-dies, fig. Q, are made of steel, and hardened: they are fitted one to the other in a very similar manner to the moulds, fig. F., before described. The lower-die, S, S, has a sliding-plug, T, fitted into it, and over that plug is a cavity which will give the required form to the back of the button. The corresponding part of the upper-die, V, V, is adapted to give form to the face of the button. The pressure which the button receives between the finishing-dies, presses down the raised edge of the shell, 6, (or of the bevil-ring, 10, which may be used in lieu thereof,) so as to clench and fasten all the parts of the button firmly together in the manner shewn by section, fig. R, and the button is flattened down to its intended thickness. The button should remain under pressure between the finishing-dies, whilst the two moulds are charging with fresh materials by a repetition of the processes hereinbefore described, and until the press is wanted for pressing the moulds another time. The sliding-plug, T, in the lower-die, is for the purpose of throwing the button out of the lower-die, when it is to be removed therefrom.

The press for pressing the moulds and pressing the finishing-dies, is represented in sheet II. The base is a strong plate, A, A, of cast-iron, which is fastened down upon the work-bench; and two standards, B, B, are erected upon it, to support two pivots, C, C, at the ends of a short axis, P, from which a lever-handle, H, projects out, being made in one piece with the axis, P, and its pivots, C, C. The part P, of the axis is an eccentric curve to act upon a clapper, F, which is moveable about a centre pin, *f*, at the further end of the base-plate, A, A, of the press, and which clapper is raised upwards by a strong piece, L, which is fixed upon the base-plate, A, A, and acts upwards beneath the clapper, F. When the handle, H, is turned upwards (as shewn in the figures) the eccentricity of the curve, P, allows the clapper, F, to rise up so high as to admit the pair of moulds, figs. D, and E, sheet 1,

(or the pair of finishing-dies, fig. Q, sheet 1,) to be placed beneath it on the base-plate, A, A, of the press; but when the lever-handle, H, is turned down, the eccentric curve, P, presses down the clapper, F, upon the top of the sliding-plug of the upper-mould. G, is a stiff spring fixed with a screw to the under-side of the clapper, F; and the end of the spring, G, is forked, to apply to the top of the upper-mould, without bearing upon the top of the plug thereof; and the clapper, F, has a tooth, X, projecting downwards through the opening of the fork, in the end of the spring, G, so as to act on the top of the sliding-plug, *f*, of the upper-mould, when the handle, H, is turned downwards. When the clapper, F, is depressed by the eccentric-curve, P, it brings down the spring, G, and causes the forked end thereof, to bear on the upper-mould with a moderate pressure, as before described, before the clapper is depressed so low that its tooth, X, comes to bear on the top of the sliding-plug, *f*, of the upper-mould. The pair of moulds, fig. F, sheet 1, or the pair of dies, fig. Q, sheet 1, are guided into their proper places on the base-plate, A, of the press by means of a plate of iron, k, which is forked to admit the under-mould, D, or the lower-die, S, in the same manner as the fork of a boot-jack receives the heel of a boot. The plate, *k*, is fitted into the space between the two standards, B, B, of the press, and fastened by a screw to the base-plate, A, A, so that it can be changed, when required, for another similar plate, to fit different sized moulds or dies.

Note.—As to the moulds, fig. F, sheet 1, for forming the button, and the tools for charging them, also the finishing-dies, fig. Q, sheet 1, for consolidating the button, and also the press, sheet II., for giving the requisite pressure to those moulds and dies, as hereinbefore described, are not newly invented implements, nor does the construction thereof form part of my present improvement in the making and constructing of buttons.

The said moulds, dies, and press, are very similar in their construction to the tools and implements used by Mr. Benjamin Sanders, in his manufactory of flexible shank buttons, at Bromsgrove, and for which tools and implements a patent was granted to him by King George the Third, dated the fourth day of November, in the fifty-fourth year of his reign (1813). I make no claim to improvement in the construction of the said tools and implements, except inasmuch as the same are modified for the purpose of making and constructing of buttons according to my improvement, in the manner hereinbefore described, and which buttons are represented at 1, 2, ~~sheet I., and have the distinctive character hereinbefore~~ set forth.

Note.—The moulds and finishing-dies should be kept as warm as the hand will conveniently endure during the making of the buttons in them, and the warmth will cause the materials to press more closely together than if the moulds and dies were cold. If the buttons have a gloss upon them when they come out of the finishing-dies, it can be removed by damping the faces of the buttons by holding them over steam arising from hot water.

As to the materials whereof buttons are to be made according to my said improvement, as hereinbefore set forth, the metal back, 5, and the metal shell, 6, (or else the blank, 9, and bevil-ring, 10,) are cut out of sheet-iron, of the thickness commonly called No. 34 gauge for iron plate for the size of button,r epresented in sheet I; and for buttons of other sizes, from No. 30 gauge, to No. 36 gauge, for iron plate. The circular pieces are cut out by beds and punches, and if an indentation at the centre of the metal back is required, it may be stamped or raised between top and bottom tools of the usual kind employed by button makers. The metal shell, fig. 6, is formed by the tools usually employed for raising up the shells of buttons. In case the blank, 9, and bevil-ring, 10, are used, in lieu of the shell, 6, then to form the said

bevil-ring, a blank is cut out of sheet-iron, rather larger than the intended button, and out of the centre of that blank a smaller blank is cut, by a second operation, with a bed and punch, leaving a narrow ring, which when raised to a bevil, by suitable top and bottom tools, forms the bevil-ring, 10. The small blank, which is so cut out of the ring, is of a proper size for the metal back, 5.

The circular pieces of cloth and paper, 7, 8, 3, and 4, are cut out by the well-known tools called beds and punches.—In witness whereof, &c.

Enrolled February 28, 1832.

ORIGINAL AND SELECTED PAPERS.

On the Laws which govern the exclusive right in certain manufactures and articles other than those secured by Letters Patent. BY THE EDITOR.

THE following note was, by a mistake of the printer, suffered to appear in our last number, page 386:

"We may remark here, that many British manufactures in which patterns of various kinds are employed require the protection of the British legislature as greatly as the cast-iron ornaments of Berlin are stated to need that of the Prussian government. If we remember right, the manufacture of brass ornaments of every description at Birmingham may be cited as an example, to which we believe calico-printing may be added.—A. T."

Our correspondent is evidently unacquainted with the laws relating to the subject in question; such things may not be protected by the laws of Prussia, but they are by the English laws; we had therefore crossed out the note not intending it to appear in the Repertory. Upon the whole however we are not sorry that the error has occurred, as we have received information since the publication, that manufacturers are generally but little acquainted with the extent of their rights when producing various articles of manufacture depending on device and certain marks of identity; such articles, though not subject matter for a

patent right, are, under certain circumstances, entitled to an exclusive right of sale by the first publisher. We therefore propose, in the present paper, to lay before our readers, as concisely as possible, the laws which relate to this description of property.

These laws are similar to those which govern the copyright of publications of books, engravings, maps, &c., though the statutes for each are distinct. In the 38th year of the reign of Geo. III. c. 71, an act was passed intituled "*An Act for encouraging the Art of making new Models and Casts of Busts and other things therein mentioned.*" This being found defective, another act of Parliament was passed, (54 Geo. III. c. 56,) intituled "*An Act to amend and render more effectual an Act of His present Majesty for encouraging the Art of making new Models and Casts of Busts and other things therein mentioned, and for giving further encouragement to such Arts.*" By this last statute the property in sculpture models and casts of almost every description, is secured to the first producer or publisher; and these are enumerated at considerable length as follows: "that from and after the passing of this act, every person or persons who shall make or cause to be made any new and original sculpture or model, or copy or cast of the human figure or human figures, or of any bust or busts, or of any part or parts of the human figure, clothed in drapery or otherwise, or of any animal or animals, or any part or parts of any animal combined with the human figure or otherwise, *or of any subject being matter of invention in sculpture*, or of any alto or basso-relievo, representing any of the matters or things hereinbefore mentioned, *or any cast from any of the matters and things hereinbefore mentioned*, whether separate or combined, shall have the sole right and property of all and every such new and original sculpture, model, cast, &c., for the term of fourteen years from the first putting forth or publishing the same." Referring back to the various articles cast in iron at Berlin, we

may divide them under two heads; first, castings of small figures, such as the King of Prussia, Napoleon, Goëthe, and various others, in whole figures and in busts; there are also casts in basso-relievo, such as the Lord's Supper, and a great variety of historical subjects. These would unquestionably be protected, if in England, by the statute above quoted. The second description of articles manufactured in Berlin, are trinkets, such as earrings, bracelets, &c.; these, probably, it might be more difficult to bring within the statute, they being made up of many small parts, and consequently are of more difficult identity, but this difficulty might be overcome by observing moderate care in making private marks which would become evident, and thus identify all copies taken from the original when that is used as a casting model. But there is another law which relates to this description of property in England, and which serves further to protect manufacturers in cases where design has no part of the merit of any particular manufacture; we mean the law which protects an individual in the use of private marks. Thus, for instance, a manufacturer having a character for making good iron or steel, denotes them by particular marks, such as a crown, a cross, or by letters of the alphabet; these are all copyright, and any other person bringing iron or steel into the market with like marks, with a view to gain a sale thereby, may be restrained from doing so by the original user of such marks; and this law has been of late years carried to a great extent in favour of manufacturers: an instance which has lately occurred, will clearly exemplify the nature and intent of this law. A patent was taken out, several years ago, for an improved plough-share. The patentee, in making the same, distinguished the different sizes of the plough-shares by certain marks, we will say, for instance, A, B, and C, thus indicating three distinct sizes or kinds applicable to three distinct ploughs, so that the owner of a plough requiring a new

share, had only to send the letter or mark, and all shares of that particular letter or mark, being made to the same mould, any one sent of the letter or mark named would be sure to fit the plough. This had become a matter of such convenience and custom, that no one thought of sending for a plough-share with any other information than the mark to the seller; it consequently happened, after the patent had expired, that other manufacturers, in making plough-shares of a like description, could not readily get a sale when the distinguishing letters were not on them, owing to the difficulty of matching a particular plough, if it should be at a distance; and parties were found to be manufacturing the plough-shares, which they had a right to do after the expiration of the patent, but they were also using the distinguishing marks of the original maker, which they had no right to do. An application was consequently made to the court of chancery, for an injunction to restrain the parties from using such distinguishing marks; which, after the case had been argued by counsel on both sides, was granted, and the parties restrained from manufacturing plough-shares having the private and distinguishing marks of the first maker. It should be borne in mind, that the patent right having expired, had nothing to do with the question; and had no patent been granted, the original maker would have been equally protected in the exclusive use of his private and distinguishing marks, though any person might make the shares, if not so marked. Another case, which came on in the court of chancery, shortly after, more strongly illustrates the nature of this law. A manufacturer had obtained considerable credit for certain descriptions and qualities of cloths sent out to the Gold Coast; they were wrapped in a peculiarly painted canvass cover, which the natives of that coast had become acquainted with, and from their knowledge of the quality of cloth usually contained therein, would purchase no others than cloths so wrapped: this

induced other manufacturers to imitate the wrapper, and to export cloths. An application was made to the court of chancery to restrain the parties; which was granted, although the wrapper was not a perfect copy, but only an imitation of the original, yet evidently intended to pass off the cloths contained as those manufactured by the original user of the particular wrapper. These two cases will be sufficient to convey a knowledge of the law, though a great variety of other cases might be cited where marks, wrappers, and even labels, have obtained, to a considerable extent, an exclusive right in particular articles of manufacture; and from the various decisions lately made in the court of chancery, we are inclined to say, that where a party can make out a case of injury by a piracy resembling the above, and where proof can be brought that the piracy is with a view to obtain a sale of articles under the credit of certain well known and distinguishing marks, such piracies would at all times be restrained by injunction on application to the court of chancery. We presume that it is well known to most persons, that no manufacturer may mark his productions with the name of any other manufacturer without consent.

We have now to speak of the laws relating to calico-printing. In the 27th year of the reign of Geo. III. an act of Parliament was passed (c. 38), intituled, "*An Act for the encouragement of the Arts of Designing and Printing Linens, Cottons, Calicoes, and Muslins, by vesting the properties thereof in the Designers, Printers, and Proprietors for a limited time.*" By this act an exclusive right was given to the first publisher of any new or original design for a term of two months from the date of publishing. In the 34th year of Geo. III. an act was passed (c. 23) for "*amending and making perpetual an act made in the twenty-seventh year of the reign of his present Majesty, intituled,*" &c. This act states "that

from and after the first day of July one thousand seven hundred and ninety-four, every person who shall invent, design and print, or cause to be invented, designed and printed, and become the proprietor of any new and original pattern or patterns for printing linens, cottons, calicoes, or muslins, shall have the sole right and liberty of printing and reprinting the same for the term of *three months* to commence from the day of the first publishing thereof, which shall be printed with the name of the printer or proprietors at each end of every such piece of linen, cotton, calico, or muslin." It will be desirable here to mention that it is necessary that the date of publication should be marked on the linen, cotton, calico, or muslin; and such also is the case with respect to models and casts: this, though not mentioned in the statute, has been ruled as necessary, in the courts of law, in order to shew the time of publishing. The term of *three months* allowed by the last mentioned statute, may at first appear to be short, but it should be remembered that patterns of muslins depend on fashion, which never lasts more than a season; thus a person being fortunate enough to bring out a favoured pattern is protected in the exclusive right of printing it for three months, by which time the season for the sale of light dresses would be over or nearly so; and it is not found desirable to copy a pattern merely to get the sale of a second season, when it must be sold at a reduced price of at least 25 per cent.; whilst the original proprietor having the blocks and designs ready made, and having in the first season been paid for the extra cost of designing, may be able, in a second season, to print at a profit even after such reduction of price, although it would not pay for making new blocks. This statute is therefore of great consequence to this part of our manufactures.

Report of Thomas Telford, Civil Engineer, February, 1834, on the Means of Supplying the Metropolis with Pure Water.

To the Right Honourable the Lords Commissioners of His Majesty's Treasury.

HAVING received directions from the Lords Commissioners of His Majesty's Treasury, to report upon the means of supplying the metropolis with pure water, I immediately proceeded in the investigation of this important object; and after extensive and repeated surveys, and much consideration, beg leave to make the following report:—

The water of the river Thames being strongly objected to by the inhabitants of this great city, and also condemned in the Report of the Commissioners of Water Inquiry [See Report, 21 April, 1828, p. 11*], in consequence of the impurities with which it is contaminated; I therefore perambulated the district on each side of the valley of the Thames, and examined the streams which fall into that river in the vicinity of London.

In the result I found an abundance of pure, transparent water, within the distance of sixteen miles on the North, amply sufficient for the supply of three of the present Water Companies on that side of the Thames; and within ten miles on the South, I found as ample a supply for the three Waterwork companies on the south side of the River, at a sufficient elevation for both high and low services, without having recourse to filtration, or, in-

* "Taking into consideration the various circumstances to which we have now adverted, together with the details of evidence by which they were proved and illustrated, and also the facts derived from our own observation and experience, we are of opinion, that the present state of the supply of water to the metropolis is susceptible of, and requires improvement; that many of the complaints respecting the supply of water are well founded, and that it ought to be derived from other sources than those now resorted to, and guarded by such restrictions as shall at all times ensure its cleanliness and purity."

deed to pumping, except for a small portion of the high services.

The circumstances of the two companies supplied with water from the valley of the river Lea, require to be spoken of separately. What relates to the companies which supply water to the north-western parts of the metropolis shall first be discussed: these are, the West Middlesex, the Grand Junction, and the Chelsea Companies.

From information obtained by the commissioners of inquiry in 1828, the daily supply of water, on an average throughout the year, afforded by each company, was as follows:

The Grand Junction	2,800,000	gallons
West Middlesex	2,250,000	—
Chelsea	1,760,000	—
In all	6,810,000	gallons or

1,089,600 cubic feet per day, equal to 78,819 gallons, or (nearly) 13 cubic feet per second.

At the town of Uxbridge, the whole of the river which passes that place is called the Colne, with which a considerable stream, called the Chesham, forms a junction at Rickmansworth; proceeding upwards, between Rickmansworth and Watford, the westerly branch occupies the Berkhamstead valley, and the eastern branch, called the Verulam, a transparent stream, occupies the St. Alban's valley, and about half-way between St. Alban's and Watford, the Colne joins the Verulam; but, unless after heavy rains, the Colne is an insignificant stream, and at such times very muddy, wherefore it is intended to exclude the Colne from furnishing any part of the supply of water to the metropolis.

At Watford mill in the autumn of 1833, being the driest season, as regards the supply of rivers, experienced during the last half century, the Verulam river produced upwards of 30 cubic feet of water per second; being

more than double the quantity supplied by the three companies in the year 1828, namely, 13 cubic feet per second, as before stated.

In the Berkhamstead valley, the river Gade, at Hunton Bridge (three miles north of Watford), in the same dry season, produced 42 cubic feet per second; but to connect the Gade with the Verulam would cost 50,000*l.*, a heavy expense, which, however, is a small objection compared to the turbid state of the Gade water, produced by its connection with the Grand Junction Canal, and the more decided cause for rejecting it altogether, from its being infected by the deleterious substances used at the paper-mills: so that there being abundance of clear water produced by the Verulam alone, at a sufficiently high elevation, I propose to avoid these annoyances altogether.

Immediately above the commencement of the intended London aqueduct, about two miles above Watford, the valley of the river Verulam affords a commodious situation for extensive reservoirs of water, and for allowing it to settle, if such should hereafter be deemed requisite.

From this place a covered aqueduct may be made to descend with a uniform inclination of 18 inches per mile to Primrose Hill, terminating in a set of extensive receiving and distributing reservoirs, at the height of 146 feet above high water, Trinity datum standard, in the river Thames; from these reservoirs each of the three before-mentioned companies may be supplied separately, and in such proportion as shall be determined.

In order to deliver the water into the reservoirs near Primrose Hill, in the same state of purity as it leaves the Verulam river, it is proposed to conduct it through a covered aqueduct, at such a depth under the surface of the ground, as to be secure from the effect of frost, from any mixture of surface-water, and from external injury by cattle or otherwise; and to preclude the unavoidable

interruptions occasioned by cleansing the water-way and effecting repairs, this aqueduct will be constructed with a double water-course, separated by a foot-path throughout its whole length.

South of the valley occupied by the Colne and Verulam, there is a narrow ridge of land, through which the aqueduct must pass by means of tunnelling; but as this ridge consists of a mass of chalk, no difficulty is to be apprehended in this operation.

I have thus given the outline of the plan I recommend, by which three of the companies on the north side of the river Thames may obtain a plentiful supply of pure water. It has already been mentioned, that in 1828 these three water companies distributed about 13 cubic feet of water per second, on an average throughout the year; but as the maximum demand of the summer months is stated to be 25 per cent. more than the average throughout the year, the maximum rate of supply by these three companies, in 1828, appears to have been 16¼ cubic feet per second; in the five years since that period, the quantity distributed is said to have been increased 25 per cent., partly from the increase of population, and partly owing to the larger demands of the inhabitants: thus I shall assume the maximum rate of demand in 1833 to be 20 cubic feet per second.

To provide for this and any future increase of water expenditure, I propose to obtain 30 cubic feet of water per second from the river Verulam, which is 10 cubic feet more than the maximum demand in the middle of summer. And if at any future period even a greater quantity should be required, reservoirs may be made for retaining the superfluous water of the Verulam, to ensure a proportionate supply; wherefore I propose that the London aqueduct should be made sufficiently large to convey an extra quantity; and that the whole of the water yielded by the river Verulam be secured for supplying the metropolis with water, should it ever be required.

South Side of the Thames.

The daily supply afforded by the three companies on the south side of the river Thames, on an average throughout the year, according to evidence produced to the commissioners in 1828, was as follows :—

The Lambeth Company	1,244,000	gallons
South London	1,000,000	—
Southwark Waterworks.	720,000	—
	2,964,000	gallons

This is equal to 474,240 cubic feet daily, or at the rate of 5½ cubic feet per second.

Thus the three companies distributed in 1828, not quite six cubic feet of water per second, all derived immediately from the river Thames.

The supply on this side of the river being under the same circumstances as that on the north side, already described, and requiring similar additions for the summer supply and for general increase during the five years elapsed since that time, the present maximum supply in the summer months may be assumed at 8½ cubic feet per second; to provide for this and any future increased demands, I propose to secure 13 cubic feet per second.

The best means of obtaining an ample supply of pure transparent water for these three companies, is by taking it from the river Wandle at a sufficiently high elevation, which is found on the Croydon branch of that river, at the east end of Beddington Park, 90 feet above high water in the river Thames. From this place an aqueduct may be carried in nearly a direct line to Clapham Common, and there terminate in a requisite number of reservoirs at a height of 82 feet above high water in the river Thames, which, except Brixton Hill (supplied by the Lambeth company), exceeds the present heights of delivery by the several companies, which are as follows :—

Lambeth	42 feet
South London	65 —
Southwark	56 —

The proposed reservoirs on Clapham Common will therefore ensure a sufficient elevation.

The main branch of the river Wandle takes its rise in a singularly copious spring in the vicinity of Croydon, and after pursuing a westerly course for about three miles, is joined by the Carshalton branch, which likewise derives its origin from several plentiful springs in that neighbourhood.

The water of this river possesses at all times an uncommon degree of purity, regaining its transparency after the heaviest rains in the course of a few hours.

The quantity of water flowing down the Carshalton branch of the river Wandle in the extraordinary dry season of 1833, was at the rate of 13 cubic feet per second; the quantity discharged by the Croydon branch, was at the rate of 17 cubic feet per second. From this last I propose to take 13 cubic feet per second, being 4½ cubic feet per second beyond the present maximum demand in the middle of summer.

From the Clapham reservoirs all the three companies may be supplied separately, and in such proportion as shall be afterwards decided, at 82 feet elevation above high water mark, Trinity standard. The new houses on Brixton Hill would be supplied with pure water by 82 feet less expense of pumping than what is at present required for this purpose.

In all the works of the six before-mentioned companies, on both sides of the Thames, some expense must be incurred in extending and adapting their mains for the reception of pure water. The quantity and method of appropriating the supply, so as to satisfy the demands of all parties, being regulated in such manner as shall, upon conferring with the engineers of the different companies, be deemed most advisable.

Expense and Remuneration.

Having shown by what means the metropolis may be amply supplied with pure water by six of the present water companies, without disturbing their present works, at an expense of about 1,177,840*l.* 16*s.* 5*d.*, including the construction of reservoirs, covered aqueducts, and connecting mains, also making compensation for water taken from mills (by substituting steam power in lieu thereof), and the value of land and damages, I conceive that I have performed the duty imposed upon me by the Lord's Commissioners of His Majesty's Treasury, that is, "In what manner the metropolis can be supplied with pure water." The manner in which any advance on the part of the public is to be repaid, being a matter of finance, I leave to be determined by others, and shall only annex a copy of what was recommended by the Directors of the Grand Junction Water-works Company, viz. they suggest that the "only course that could be pursued to avoid a ruinous waste of capital, and a consequent loss to the public, is, that the commissioners should be directed to ascertain the best mode of obtaining the supply required; that government should advance the sum requisite to bring the water to the spot from whence the companies could receive it into their several works upon the security of their respective incomes, as has been done in other public undertakings [illegible] that the outlay should be under the supervision of some parliamentary authority [illegible] that the increase of rates to be charged by each [illegible] should be no more than [illegible] proportion of interest [illegible] should respectively [illegible] government."

This seems a fair [illegible] judicious prop[illegible] constant annual out[illegible] saved to the Water[illegible] that can be saved, [illegible] of the interest on [illegible]

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ficent work from which the metropolis derives so great a portion of its supply of pure water, it being well known to have been accomplished by Sir Hugh Myddleton in the reign of James the First, after encountering many difficulties, and not without his royal assistance. I shall therefore confine my observations to its present state.

The river Lea is the drain of a valley in the great chalk ridge which intersects the county of Hertford. This is a considerable stream, adjacent to the town of Hertford, and in its progress towards the Thames, by Waltham Abbey, its waters are much augmented by a junction with its tributary streams, Theash and Stort, which fall into the main river some distance below the town of Ware.

In the valley of the Lea, and in the neighbourhood of Ware, two singularly copious springs issue from the foot of the Chalk Hills. The upper and greater is named the Chadwell Spring; the other, which is below the town of Ware, the Amwell. The quantity and transparency of these springs were the inducements for taking the water from this place for the supply of the metropolis; more especially as the position was found sufficiently high to enable the projectors to carry the water along a very circuitous artificial aqueduct of 37 miles in length to the suburb of Islington, where it terminates at the height of 84 feet above the river Thames, whence it is distributed over a large district; and having been maintained with great care and expense, has afforded an ample supply of water to the inhabitants.

But during two centuries the population of the metropolis has greatly increased, and along the whole length of the aqueduct villages and splendid mansions have arisen, so that the consumption of water has also greatly increased, wherefore, by several acts of Parliament, authority has been granted for drawing an additional quantity from the river Lea.

In the distribution of the water produced in the valley of the river Lea, three objects require attention :

1st. The supply of a great portion of the metropolis with pure water.

2nd. The navigation of the River Lea between the town of Hertford and the Thames.

3rd. The water-power of the mills upon the River Lea, including the government mills at Waltham Abbey.

An ample supply for the metropolis ought certainly to be secured in the first instance, because the two other objects may, if absolutely necessary, be otherwise provided for; moreover, upon investigating the subject, I am convinced, that by judicious arrangement, all these three purposes may be combined and accomplished.

The appropriation of the water of the Lea has, during the last century, been the subject of much litigation, and the most eminent engineers, viz. Sir Christopher Wren, Desaguliers, Smeaton, and Rennie, have been employed; and, lastly, the supply of water and the comparative levels have been carefully ascertained under my direction.

Upon consideration of the entire subject, I am of opinion that the law, as it now exists, ought not to be disturbed.

I also understand that since the year 1828 conferences have taken place, and the outline of a scheme suggested, which, with such modification as existing circumstances require, would be satisfactory to all parties concerned; and this, I hope, will be completed without delay.

The quantity of water delivered to the inhabitants of London and its vicinity by the New River Company, as stated to the Commissioners of Water Inquiry in 1828, was at the rate of 24 cubic feet per second, and this being required to supply the usual consumption of the inhabitants, must be carefully preserved.

The entire quantity of water flowing down the river Lea in November, 1833 (after supplying the New River), as measured at the King's Wear, above Waltham Abbey powder-mills, was found to be 110 cubic feet per second. As this was at the end of an unusually dry season, there

will always be an ample supply for navigation and mill-power, as I do not recommend that any water be taken from the river below the town of Ware until after it has passed the government establishment at Waltham Abbey.

By the contemplated arrangement a division of the water would be adjusted, litigation prevented, and the metropolis supply, to a known extent, secured. But to meet the continually increasing demands of the inhabitants, and to compensate the loss of the Amwell spring (which has abandoned the New River), and now finds its way into the Lea, it is necessary to enable the Company to provide a still greater quantity of water, and also to preserve it in greater purity; but to accomplish this further parliamentary authority is required.

1st. In order to obtain an additional quantity of pure water, without interfering with the contemplated arrangements, the Company should be required to pump water from the river Lea some miles below the government works at Waltham Abbey, towards which purpose they have purchased Tottenham Mill, and 30 acres of land adjacent, and constructed reservoirs to the extent of 30 acres of water adjoining the New River, at Newington, and adjacent to the site of Tottenham Mills; and there being also an old branch of the river Lea at present not in use, it should be transferred to the New River Company, who thereupon should be required to embank and enlarge it, not less than 20 acres, and convert it into a setting reservoir, upon which the pumping engines should be placed.

In regard to the power of the engines to be constructed and employed, in order to guard against the effects of long-continued frosts, or unusual droughts, or being under the necessity of pumping from the river Thames, at Broken Wharf, the engines should be capable of raising two-thirds of the whole supply. This additional quantity being thrown directly into the reservoirs at Newington, would have the advantage of being in the vicinity of the

city, and create no further expense of conduit or other conveyance.

If the water is taken off at Tottenham, all the mills upon the river above that place, including the Royal Gunpowder Mills at Waltham Abbey, would still possess the entire water of the river, and if a quantity equal to two thirds of what is supplied to the metropolis by the New River (viz. 16 cubic feet per second) were drawn off by the engines at Tottenham, 94 cubic feet per second would still remain for the use of the mills below.

To guard against any injury that may arise to the navigation of the river Lea, in consequence of the powers herein recommended to be given to the New River Company, that Company should be required to re-build the lock at Tottenham Mill in a perfect manner, and keep it in repair; also to pay a fair and reasonable sum to the trustees of the river Lea navigation, to be expended in deepening the river Lea where found necessary.

2nd. The quantity of water requisite in aid of the New River, being thus adjusted, it becomes of importance to preserve that stream from impurities while passing along a circuitous course of 37 miles in length. I was, at first sight, disposed to recommend its being made more direct, by cutting off great bends, embanking valleys, &c.; but on survey, finding it of quite sufficient dimensions to convey all the water that the Company had a right to take, also that the stream itself is, in effect, a very extensive reservoir, and that much expense would attend the proposed alterations, I consider it more advisable to adopt other means of improvement.

Where the New River commences at the Chadwell spring, the water is generally pure and transparent; but in passing 37 miles of a populous vicinity without protection, it is unavoidably exposed to various impurities; the surface-water from the uplands, sewages from the villages, cattle treading down the edges of the river-banks, all combining to produce discolouration of the

water, which is still more increased by the operations necessary to restore the banks, and near the metropolis by numerous persons bathing and creating other nuisances. The Company should, therefore, be empowered and required to collect the water and sewage from the uplands and villages, and convey it under the New River to proper water-courses; and they should also be required to fence each side of the River in a proper manner, so as to prevent the evils above-mentioned, preserving a space between the fence and water, of at least six feet in breadth, for the passage of workmen, making reasonable compensation to the proprietors of the adjoining lands.

The Company should also have the power of summary punishment of trespassers, on conviction before magistrates; and the landowners and occupiers should be prevented from digging deep ditches at the bottom of the slopes, thereby weakening and endangering the banks.

3rd. In regard to defraying the expense of the improvements here proposed, it appears that since the year 1828, the Company have completed some very considerable works, such as the Newington reservoirs, of 38 acres, defraying the expense from their annual income; and I understand by their letter to the Treasury of July, 1831, that they are able and willing to continue the improvements in the same manner, if parliamentary powers were granted them.

4th. To insure the improvements being properly executed, and the water duly distributed, the before-mentioned parliamentary commissioners should be empowered to examine into and decide any differences which may arise among the parties interested in the supply and purity of the water, which would prevent disputes, such as have already been productive of expensive litigation without satisfactory result.

The East London.

The East London Water-works Company supply a

very large and increasing district, being the north-eastern portion of the metropolis. The water-works are situated at Old Ford, in the river Lea, just above Bow-bridge, and consist of a powerful apparatus of steam-engines and pumps, of the aggregate force of about three hundred horses, for raising and distributing water.

The water has hitherto been brought from the river Lea at high water, into a large settling reservoir on the north thereof, from whence it passes by pipes under the same river into smaller reservoirs, from which the pumps are supplied.

From this arrangement it is evident, that although the water taken from the reservoirs and distributed, is in fact from the river Lea, yet it is the water of the Lea subjected to the contamination of the district through which it passes in and below the neighbourhood of Bow, and to the constant agitation of the tides in driving upwards towards the water-works during the flood-tides; thus rendering it no better, as far as regards matter held in suspension, than the water of the Thames taken up in its passage through the metropolis.

After the Commissioners of Inquiry into the quantity and quality of water supplied to the metropolis had made their report in 1828, the East London Water-works Company took immediate steps to improve their water, both in quantity and quality, by obtaining powers under an act of Parliament, in the year 1829 [10 Geo. 4, cap. cxvii. local and personal], to take water from the river Lea at or near Lea-bridge mills, above the influence of the tide, and to convey it from thence to the works at Old Ford, by means of a new aqueduct (insulated from all other water), into settling reservoirs, upwards of eighteen acres in extent, from which it passes into reservoirs, out of which the pumps are supplied as before stated.

These works are now on the eve of completion, and will be in action in the month of June of the present year, within the time allowed by the Act of Parliament.

In the prosecution of these improvements, the East London Water-works Company have expended upwards of 50,000*l.*, without having the power of imposing additional rates or charges on their customers; the maximum charges of housekeepers or private consumers being fixed by the act.

Having assured myself, by a personal survey of the Water-works at Old Ford, and by an inspection of the new aqueduct and reservoirs now near completion, for taking water from the river Lea at the tail of the Lea-bridge mills, that the above statements are correct; in which survey and inspection every facility was afforded by the directors of the Company, in furnishing information, and in the production of all documents deemed by me necessary for the investigation of the subject, I have no hesitation in stating, that, as far as the East London Water-works are concerned, the improvements necessary for ensuring a better supply of pure water to their district have been anticipated by that Company.

The only point upon which any question might arise is rather of a prospective nature, inasmuch as it relates to the sewage of the district on the West side of the river Lea, between Tottenham mills and Lea-bridge mills, which sewage is now discharged into the Lea; but should a greater number of buildings, or a town, grow upon that side of the river, it would then be advisable to carry the sewage of that district clear of the portion of the river above named, either by conveying it under the river at one or more points, or by connecting it with the Hackney sewage, which goes into the tideway of the river Lea below Old Ford lock. But this is a part of the subject which might with propriety come under the control of a general commission for the conservation of the water supplied to the metropolis.

Regarding the quantity of water now used, or likely to be required by the Company, there is no doubt the river Lea possesses an abundance.

By the returns made to the Commissioners of Inquiry in 1828, it appears that the quantity then distributed by this Company was 11 cubic feet per second in the aggregate, and making the due allowances for the extra quantity used in the warmest weather at 25 per cent. increase, adding, moreover, 25 per cent. for increase since that time, the amount would now be about 16 cubic feet per second, and allowing another 25 per cent. for future demands, it gives a total of 20 cubic feet per second, as the greatest probable quantity required by this Company.

Now, it appears that the river Lea (as above stated in the Report on the New River) produces, in the times of shortest water, a surplus quantity of 94 cubic feet per second, after deducting what might probably be wanted by the New River Company in times of drought; and as the quantity required for the East London Company is not taken off until after passing through Lea Bridge Mills and supplying all the wants of the navigation, there will still remain the above surplus of 94 cubic feet per second, for supplying the probable maximum demand of 20 cubic feet per second required by the East London Company.

London, THOMAS TELFORD.
February 17, 1834.

CRITICAL NOTICES AND REVIEWS.

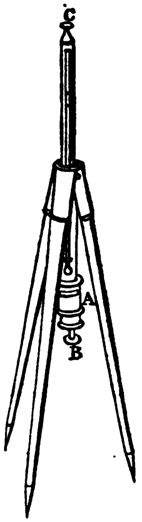
A Treatise on the Principal Mathematical Instruments employed in Surveying, Astronomy, &c. &c. By FREDERICK W. SIMMS. London: 1834.

THE object of the author or compiler of this little work, is to bring within a small compass a clear description of the instruments used in surveying, astronomy, &c., and thus placing in the hands of the student a book

of reference, by which he may readily obtain the requisite information for examining and rectifying the adjustment of his instruments, and obtaining in their use the most accurate results.

We have examined the work with considerable attention, and find the descriptions of the mechanical details of the various instruments, together with the instructions for using them, concise and clear, displaying an accurate knowledge of the parts as well as the means of adjusting them; and this knowledge is conveyd in an easy manner to the reader.

We shall make one extract, relating to levelling with the barometer, by which the work will speak for itself.



The employment of the barometer for the determination of heights, has caused it to become an interesting instrument to the philosopher and the traveller; and many attempts have been made to improve it, and render it portable, that it may be conveyed from place to place, without much inconvenience or risk. The adjoining figure represents the portable barometer as constructed by Mr. Troughton. In the brass box, A, which covers the cistern of mercury near the bottom of the tube, are two slits made horizontally, precisely similar and opposite each other, the plane of the upper edges of which represents the beginning of the scale of inches, or zero of the barometer. The screw B, at the bottom, performs a double office; first, it is the means of adjusting the surface of the mercury in the glass cistern to zero, by just shutting out the light from passing between it and the upper edges of the above-named slits; and secondly, by screwing it up, it forces the quicksilver upwards, and by filling every part of the tube renders the instrument portable.

The divided scale on the upper part, is subdivided by the help of a vernier, to the two-thousandth of an inch. The screw C, at the top, moves a sliding-piece, on which the vernier scale is divided, the zero of which is at the lower end of the piece. In taking the height of the mercury, this sliding piece is brought down and set nearly by the hand, and the contact of the zero of the vernier with the top of the

mercurial column is then perfected by the screw C, which moves the vernier the small quantity that may be required, just to exclude the light from passing between the lower edges of the sliding-piece, and the spherical surface of the mercury.

The barometer is attached to the stand by a ring, in which it turns round with a smooth and steady motion, for the purpose of placing it in the best light for reading off, &c.; and the tripod stand, when closed, forms a safe and convenient packing case for the instrument.

A thermometer is always attached to the lower part of the barometer, to indicate its temperature; while another, detached from the instrument, is employed at the same time, to shew the temperature of the surrounding air.

The barometrical method of determining differences of level, is founded upon the principle that the strata of air decrease in density, in a geometrical proportion, when the elevations above the surface of the earth increase in an arithmetical one. Therefore, from the known relation between the densities and the elevations, we can discover the elevations by observations made on the densities by means of the barometer.

Observe at the same time the height of the mercurial columns at both the stations, whose difference of elevation is required, and also the temperature of the instrument by the thermometer attached thereto; and that of the surrounding air by another, called the detached thermometer.*

The computations for deducing the difference of height from these observations, is rendered very easy by means of Table II. which is computed by the formula given by Mr. Baily, in his volume of Astronomical Tables and Formula, and is similar to Table XXXVI. in the same volume, but more extended.

The following is the method of using the Table.

Find in the column headed S the sum of the degrees read on the detached thermometers at the two stations, and take out the corresponding number from the adjoining column, headed A; next, in the column D, find the difference of the degrees read on the attached thermometers, and take out the opposite number in the column B; lastly, from the column C, take out the number opposite the latitude of the place of observation, found in the column L.

Now, to the number called B, add the log. of the height of the barometer at the upper station, and subtract their sum from the log. of the height of the barometer at the lower station, and call the remainder R; then take out the log. of R, and add it to the numbers A

* The mean result of several observations should be taken as that to be used for computation.

and C, and the sum, rejecting tens from the index, will be the log. of the difference of the altitudes of the two stations in feet.

EXAMPLE.

The following observations were made in the transit-room of the Royal Observatory, and at the base of the statue of George II. in Greenwich Hospital, latitude 51° 28′ to determine the difference of altitude.

	Upper Station.	Lower Station.
Detached thermometer	71° 5	71° 5
Attached ditto	70 0	70 0
Barometer, mean of obs.	29 870 inches	30 014 in.

A = 4.81719

B = ... 0.00000

C = 9.99976

log. of bar. upper station, 1.47524

1.47524

log. of bar. lower station, 1.47732

7.31806 log.......... ..... R = 0.00208

Sum 2.13501 log. of 136.46 feet, the diff. of altitude.

The difference of altitude, as obtained by levelling with the spirit-level (Phil. Trans. 1831, Part I.) = 135.57 feet, differing only 0.89 feet from that obtained above. Hence we see to what a degree of accuracy differences of level may be determined by the barometer. The observations should be made simultaneously at both stations, but to do this, two observers and two barometers are required. When there is only one observer, he should, after making his first observations, lose no time in hastening to his second station, to make his observations there; which, if done quickly, and the atmosphere is undergoing no change at the time, will answer nearly as well as if simultaneous observations were made by a barometer at each station.

TABLE II.

For determining Altitudes with the Barometer.

Computed by Mr. Baily's Formula XXXVIII.

Thermometers in open Air.						Thermometers to the Barometer.		Latitude of the Place.	
S	A	S	A	S	A	D	B	L	C
40°	4·76891	84°	4·79019	128°	4·81048	0°	0·00000	0°	0·00117
41	·76940	85	·79066	129	·81093	1	·00004	3	·00116
42	·76989	86	·79113	130	·81138	2	·00009	6	·00114
43	·77039	87	·79160	131	·81183	3	·00013	9	·00111
44	·77089	88	·79207	132	·81228	4	·00017	12	·00107
45	4·77138	89	4·79254	133	4·81272	5	0·00022	15	0·00101
46	·77187	90	·79301	134	·81317	6	·00026	18	·00095
47	·77236	91	·79348	135	·81362	7	·00030	21	·00087
48	·77286	92	·79395	136	·81407	8	·00035	24	·00078
49	·77335	93	·79442	137	·81451	9	·00039	27	·00069
50	4·77383	94	4·79488	138	4·81496	10	0·00043	30	0·00059
51	·77433	95	·79535	139	·81541	11	·00048	33	·00048
52	·77482	96	·79582	140	·81585	12	·00052	36	·00036
53	·77531	97	·79629	141	·81630	13	·00056	39	·00024
54	·77579	98	·79675	142	·81675	14	·00061	42	·00012
55	4·77628	99	4·79722	143	4·81719	15	0·00065	45	0·00000
56	·77677	100	·79768	144	·81763	16	·00069	48	9·99988
57	·77726	101	·79814	145	·81807	17	·00074	51	·99976
58	·77774	102	·79860	146	·81851	18	·00078	54	·99964
59	·77823	103	·79907	147	·81896	19	·00083	57	·99952
60	4·77871	104	4·79953	148	4·81940	20	0·00087	60	9·99941
61	·77920	105	·79999	149	·81983	21	·00091	63	·99931
62	·77968	106	·80045	150	·82027	22	·00096	66	·99922
63	·78017	107	·80091	151	·82072	23	·00100	69	·99913
64	·78065	108	·80137	152	·82116	24	·00104	72	.99905
65	4·78113	109	4·80183	153	4·82160	25	0·00109	75	9·99899
66	·78161	110	·80229	154	·82204	26	·00113	78	·99893
67	·78209	111	·80275	155	·82248	27	·00117	81	·99889
68	·78257	112	·80321	156	·82291	28	·00122	84	·99886
69	·78305	113	·80367	157	·82335	29	·00126	87	·99884
70	4·78353	114	4·80412	158	4·82379	30	·00130	90	9·99883
71	·78401	115	·80458	159	·82422	31	0·00134		
72	·78449	116	·80504	160	·82466				
73	·78497	117	·80549	161	·82510				
74	·78544	118	·80595	162	·82553				
75	4·78592	119	4·80641	163	4·82597				
76	·78640	120	·80687	164	·82640				
77	·78688	121	·80732	165	·82683				
78	·78735	122	·80777	166	·82726				
79	·78783	123	·80823	167	·82770				
80	4·78830	124	4·80869	168	4·82813				
81	·78878	125	·80914	169	·82857				
82	·78925	126	·80958	170	·82900				
83	·78972	127	·81003	171	·82943				
84	4·79019	128	4·81048	172	4·82986				

S = the sum of the detached thermometers at the two stations.

D = the difference of the attached thermometers at the two stations.

L = the latitude.

β = the log. of the barometer at the upper station.

β' = the log. of the barometer at the lower station.

Make $R = \log. \beta' - (B + \log. \beta)$

The log. diff. of altitude in English feet = A + C + log. of R.

NOTICE OF EXPIRED PATENTS,

(*Continued from p.* 403, *Vol. I.*)

John Malam, of Romney Terrace, Horseferry Road, Westminster, Middlesex, Engineer, for certain improvements on gas-meters.—Sealed May 11, 1820.

Samuel Kenrick, of West Bromwich, Staffordshire, Manufacturer, for an improved method of tinning cast-iron vessels of capacity. —Sealed May 13, 1820.—(*For copy of specification, see Repertory, Vol.* 40, *second series, p.* 335.)

Robert Wornum, of Wigmore Street, Cavendish Square, Middlesex, Piano-forte Maker, for an improvement on piano-fortes, and certain other stringed instruments.—Sealed May 13, 1820.—(*For copy of specification, see Repertory, Vol.* 41, *second series, p.* 91.)

Robert Bill, of Newman Street, Oxford Street, Middlesex, Esq., for an improved mode of constructing beams, masts, yards, bow-sprits, and other parts of ships, vessels, and crafts, used for the purpose of navigation, and of other parts of the rigging of such ships, vessels, and craft.—Sealed May 15, 1820.

John Barton, of Falcon Square, London, Engineer; for certain improvements in propelling, and in the construction of engines and boilers applicable to propelling, and other purposes.—Sealed May 15, 1820.—(*For copy of specification, see Repertory, Vol.* 40, *second series, p.* 136.)

Richard Watts, of Crown Court, Temple Bar, Middlesex, Printer, for improvements in inking printing-types with rollers, and in placing and coveying paper on types, and in inking with a cylinder. —Sealed May 15, 1820.

Robert Winch, of Shoe Lane, London, Press Maker, for certain improvements on machines, or presses, chiefly applicable to printing. —Sealed May 18, 1820.

Edward Massey, of Eccleston, Prescot, Lancashire, and also of Coventry, Watch Manufacturer, for certain improvement in the construction of chronometers and pocket watches.—Sealed May 19, 1820.

John Hague, of Great Pearl Street, Spitalfields, Middlesex, Engineer, for an improvement in preparing the materials for making pottery-ware, tiles, and bricks.—Sealed June 2, 1820.

William Bate, of Peterborough, Northamptonshire, Esq., for a combination of, and additions to, machinery calculated to increase power.—Sealed June 3, 1820.

LIST OF NEW PATENTS.

George Bather, of the Haymarket, in the Parish of St. James, Westminster, Scale Maker, for a weighing machine upon a new construction.—Sealed May 22, 1834.—(*Six months.*)

Thomas Edmonds, of Burton Street, in the Parish of St. George, Hanover Square, in the County of Middlesex, for a certain process or method of manipulation and treatment for the preparation of leather, whereby it becomes less pervious to water, and preserves better its pliability during use, than does leather prepared by the ordinary means.—Sealed May 22, 1834.—(*Six months.*)

Joseph Morgan, of Manchester, in the County of Lancaster, Pewterer, for certain improvements in the apparatus used in the manufacture of mould candles.—Sealed May 22, 1834.—(*Six months.*)

Charles Louis Stanislas Baron Heurteloup, of Holles Street, Cavendish Square, in the County of Middlesex, for improvements in certain parts of certain descriptions of fire arms.—Sealed May 22, 1834.—(*Six months.*)

Andrew Smith, of Princes Street, Leicester Square, in the County of Middlesex, Machinist and Engineer, for a new and improved method of preparing phormium tenax, hemp flax, and other fibrous substances, and rendering the same fit for hackling in the manufacture of linen, and for spinning in the manufacture of ropes, cordage, lines, and twines.—Sealed May 24, 1834.—(*Six months.*)

Luke Smith, of Manchester, in the County of Lancaster, Cotton Manufacturer, and John Smith, of Hepwood, in the same County, Machine Maker, for certain improvements in weaving machinery.—Sealed May 24, 1834.—(*Six months.*)

Philip Augustus De Chapeaurouge, of Fenchurch

Street, in the City of London, Gentleman, for a machine-engine or apparatus for producing motive-power, which he denominates a self-acting motive-power, and called in France, by the inventor "Voland moteur perpetual." Communicated by a foreigner residing abroad.—Sealed May 24, 1834.—(*Six months.*)

Stephen Hawkins, of Milton House, near Portsmouth, in the county of Hants., Gentleman, for certain improvements in warming pans or apparatus for warming beds and other purposes.—Sealed May 24, 1834.—(*Six months.*)

John George Bodmer, of Bolton-le-Moors, in the County of Lancaster, Civil Engineer, for certain improvements in steam engines and boilers applicable both to fixed and locomotive engines.—Sealed May 24, 1834.—(*Six months.*)

John George Bodmer, of Bolton-le-Moors, in the County of Lancaster, Civil Engineer, for certain improvements in the construction of grates, stoves, and furnaces, applicable to steam-engines and many useful purposes.—Sealed May 24, 1834.—(*Six months.*)

William Crofts, of New Radford, in the County of Nottingham, for certain improvements in certain machinery for making lace, commonly called bobbin net lace.—Sealed May 27, 1834.—(*Six months.*)

William Henry Hornby, of Blackheath, in the County Palatine of Lancaster, Cotton Spinner and Merchant, and William Kenworthy, of Blackburn, aforesaid, Engineer, for certain improvements in power-looms to be used in the weaving of cotton, linen, silk, woollen, and other cloths.—Sealed May 27, 1834.—(*Six months.*)

Richard Simpson, of Southampton Row, Bloomsbury, in the County of Middlesex, Gentleman, for improvements in machinery for roving and slubbing cotton and wool. Communicated by a foreigner residing abroad.—Sealed June 3, 1834.—(*Six months.*)

John Bertie, of Basford, in the County of Notting-

ham, Machinist, and James Gibbons, of Radford, in the same County, Machinist, for an improved texture of the lace-net, hitherto called bobbin-net or twist-net, and also certain improvements in lace-machinery, in order to produce lace-net with the said improved texture, either plain or ornamented.—Sealed June 5, 1834.—(*Six months.*)

George Saint Leger Grenfell, of Paris, in the Kingdom of France, Merchant, at present residing at No. 4, Cadogan Place, Sloane Street, in the County of Middlesex, for certain improvements in the constructions of saddles. Communicated by a foreigner residing abroad. —Sealed June 5, 1834.—(*Six months.*)

Edward Keele, of Titchfield, in the County of Southampton, Brewer, for an improved valve and apparatus for close fermenting and cleansing porter, beer, ale, wine, spirits, cider, and all other saccharine and fermentable fluids.—Sealed June 7, 1834.—(*Six months.*)

Thomas Ridgway Bridson, of the Township of Great Bolton, in the Parish of Bolton-le-Moors, in the County of Lancaster, Bleacher, for certain improvements in machinery or apparatus to be used in the operation of drying cotton, linen, and other similar manufactured goods. Communicated by a foreigner residing abroad.—Sealed June 10, 1834.—(*Six months.*)

James Whitaker, of Wardle, near Rochdale, in the County of Lancaster, Flannel Manufacturer, for certain improvements in engines used for carding wool.—Sealed June 12, 1834.—(*Six months.*)

Matthew Bush, of Dalmonarch Printfield, near Bonhill by Dunbarton, North Britain, Calico Printer, for certain improvements in machinery or apparatus for drying and printing calicoes and other fabrics.—Sealed June 14, 1834.—(*Six months.*)

James Lee Hannah, of Brighton, in the County of Sussex, Doctor of Medicine, for a certain improvement or certain improvements in surgical instruments for reduc-

ing the stone in the bladder and enabling the patient to pass it off through the urethra.—Sealed June 16, 1834.—(*Six months.*)

Joseph Jones, of Oldham, in the County Palatine of Lancaster, Cotton Manufacturer, and Thomas Mellodew, of the same place, Mechanic, for certain improvements in the construction of power-looms, and in the manufacture of certain kinds of corded fustian or fabric to be woven in diagonal cords, from cotton, wool, and other fibrous materials.—Sealed June 16, 1834.—(*Six months.*)

Charles Wilson, of Kelso, in the County of Roxburgh, for certain improvements applicable to the machinery used in the preparation for spinning wool and other fibrous substances.—Sealed June 17, 1834.—(*Six months.*)

Isaac Jecks, jun., of Bennett's Hill, in the City of London, Gentleman, for an apparatus or machine for putting or drawing on or off boots.—Sealed June 17, 1834.—(*Six months.*)

William Symington, of Bromley, in the County of Middlesex, Cooper, and Andrew Symington, of Falhland, in Fifeshire, in that part of the United Kingdom called Scotland, Watchmaker, for a paddle-wheel of a new and useful construction for the propulsion of vessels and other motive purposes.—Sealed June 23, 1834.—(*Six months.*)

John Chester Lyman, of Golden Square, in the County of Middlesex, Gentleman, for certain improvements in hulling, cleansing, or polishing rice, bearding or peeling barley, and hulling and cleansing coffee. Communicated by a foreigner residing abroad.—Sealed June 24, 1834.—(*Six months.*)

THE

REPERTORY

OF

PATENT INVENTIONS.

No. VIII. NEW SERIES.—AUGUST, 1834.

Specification of the Patent granted to BARTHELEMY RICHARD COMTE DE PREDAVAL, *of Leicester Place, Leicester Square, in the County of Middlesex, Engineer, for an Engine for producing Motive Power applicable to various purposes.*—Sealed November 19, 1833.

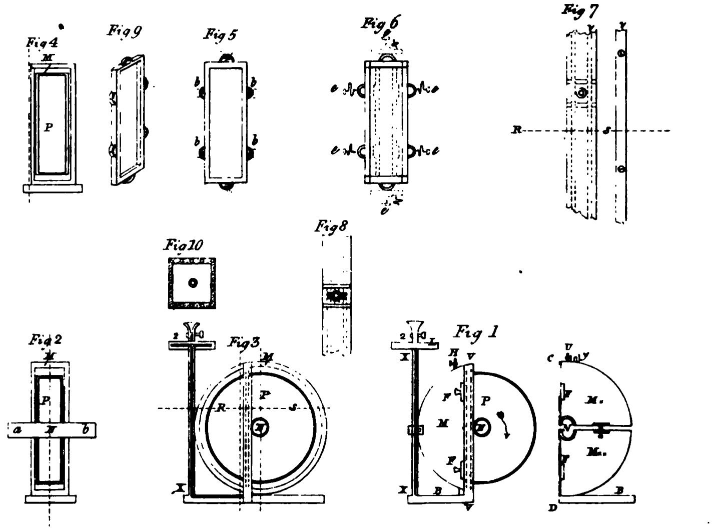
WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Barthelemy Richard Prédaval, do hereby declare the nature of my said invention to consist in a rotary engine receiving its motion from the buoyancy of any suitable fluid acting on one part of it, and from the inclination of a corresponding part to fall by its own weight in vacuo, and in further compliance with the said proviso, I, the said Barthelemy Richard Prédaval, do hereby describe the manner in which my said invention is to be performed, by the following statement thereof, reference being had to the drawing annexed and to the figures and letters marked thereon (that is to say):

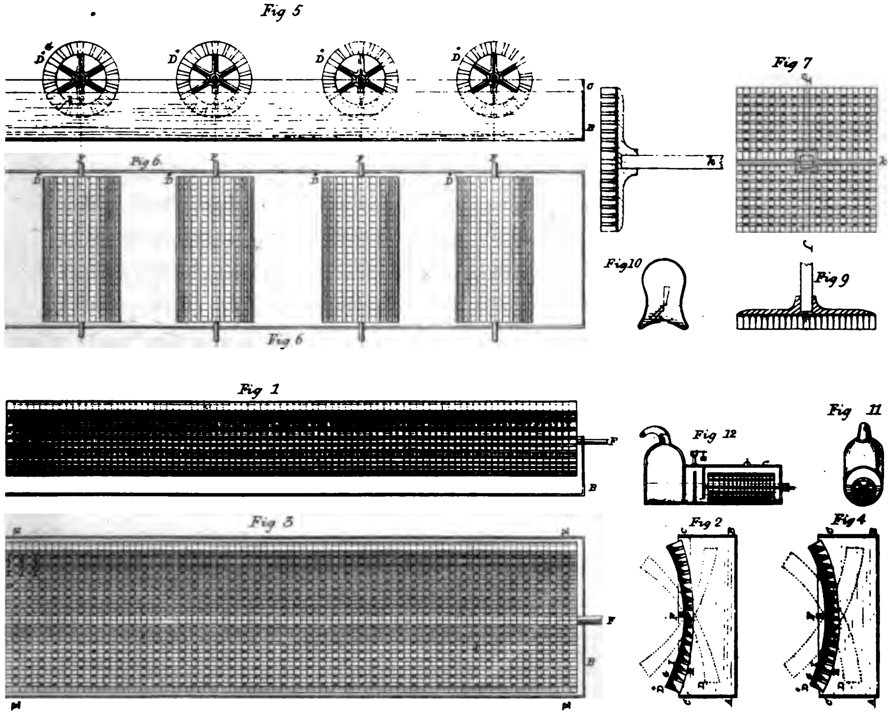
Description of the Drawing.

Fig. 1, is a side-view of an engine made on the principle of my said invention, with part of it removed, the better to shew its internal construction. M, M, M, is an outer circular-case, supported on the stand, B, B. P, is a hollow water and air-tight drum or cylinder, corresponding in shape with the case, M, and turning on an axis, N, and working in a stuffing-box. This axis is fixed to a cylinder or drum, and passes through the case at each side, and is supported by it. The external surface of the drum should be perfectly smooth. V, V, represents the edge of a square frame, which I call the division-frame, and is shewn separately at fig. 9. This frame contains pistons, or friction-plates, which are more particularly described hereafter, and which fill up the space between the inner-drum and the outer-case, on all four sides, and should press close upon the inner-drum, in the manner of pistons, as will be more particularly explained hereafter. They divide the space between the outer-case and inner-drum into two parts. It will be observed that the friction-plates are shewn in this figure in a position behind this axis, whence it follows that one part of the space divided is smaller than the other, the larger part being formed by the two pieces, M*, and M**, before mentioned, as being removed to shew the interior arrangement of the engine. These parts being put to their places complete the outer-case; they are screwed to the outer part of the case, M, by flanges at F, F, and should make the larger compartment of the outer-case air tight. The smaller portion of the space between the outer-case and the drum, say at M, is then filled with water through the pipe, X, X; and it should here be stated, that the proportions of the engine should be so calculated that the weight of the water in the case may be twice and a half heavier than that part of the cylinder or drum, which is to be surrounded by the

Pridaval's Patent



Kneller's Patent



London. Simpkin & Marshall. for the Proprietor Aug. 1. 1834.

water. The pipe, x, x, is kept in its place by a bracket, or arm, z, projecting from the side of the outer-case; and this pipe is furnished with a stop-lock at each end. At the top of the pipe is a flat reservoir, L, above which one of the stop-cocks is placed. This reservoir should be equal in extent of surface to the extent of surface on the plane of projection exhibited by the water in the outer-case. H, is a cock to allow the air to escape when the water is entering; and U, is another air-cock, to which an air-pump is to be attached to cause the vacuum in that part of the space between the case and the drum, opposite to where the water is. Y, is a mercurial gauge to ascertain when the vacuum is sufficiently perfect. Now it results from a machine so constructed that that part of the drum, P, which is in the water, will have a constant tendency to rise or be buoyed up by the water, while the other part of the drum which is in vacuo will have as constant a tendency to fall, or, in other words, that part of the drum which is in vacuo will always be heavier than that which is in the water, and the consequence will be, that the drum will be constantly turning on its axis so long as the vacuum is kept up in one part of the machine, and the water is in the other; and it is scarcely necessary to add, that the axis in that case may be made to turn any working-shaft.

Fig. 2, is an elevation of a part of the machine in section.

Fig. 3, is a side-elevation of a part of the machine in section.

Fig. 4, is a section through the case and drum, taken at the red line* in fig. 2.

Fig. 5, is a separate view of the hollow frame before alluded to, having the four pistons inclosed, one in each side and one in each end of it. The pistons are acted upon or pressed out by small springs acting, as here shewn, between the bridges, *b*, *b*, *b*, *b*, and the pistons.

* Shewn by dotted lines in the plate.

The pistons are placed in the frame from the inside, and the screw-nuts, *e*, *e*, *e*, *e*, *e*, *e*, screwed on to the end of the springs that protrude though a small hole made in the top of each bridge for that purpose.

Fig. 6, is a view of the hollow frame aforesaid, in section, with two of the pistons ready to be placed in it, from the inside, after which the other two would also be placed in like manner from the inside.

Fig. 7, is an edge-view of a part of one of the pistons, the part coloured green being leather or other packing, and that coloured red, brass, copper, or other metal plates, on each side of it to hold it firmly together.

Fig. 8, is a view of one of the bridges on the edge of the hollow frame on a larger scale. It will be seen that there is a small plate of iron immediately under the spring on which it acts, and which extends across the leather, and rests at each end upon the brass or copper plates of the piston; and

Fig. 9, is a separate view of the said frame with the pistons removed.

Fig. 10, is a plan of the reservoir, L.

Now whereas, my said engine may be made of iron, copper, or any suitable metal, and its particular form may of course be varied to suit particular localities.

But whereas, I claim as my invention the engine or machine hereinbefore described, acting by a joint-power derived from the buoyancy of a body in fluids, and the weight of a body in vacuo, and such my invention being, to the best of my knowledge and belief, entirely new and never before used within that part of his said Majesty's United Kingdom of Great Britain and Ireland called England, his said dominion of Wales, or Town of Berwick-upon-Tweed; I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply in all respects fully and without reserve or disguise with the proviso in the said hereinbefore in part recited letters patent con-

tained, wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.—In witness whereof, &c.

Enrolled May 19, 1834.

Specification of the Patent granted to William Godfrey Kneller, *of Mitcham, in the County of Surrey, Chemist, for certain Improvements in Evaporation.*—Sealed August 24, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said William Godfrey Kneller, do hereby declare that the nature of my improvements in evaporation, consists in the employment of certain apparatus, or machinery, whereby I am enabled to effect the sudden compression of common atmospheric air, conveyed, by means of inverted moveable chambers, or ventilators, filled therewith, and depressed below the surface of the heated fluids or liquids, to be evaporated; and which said volumes of air, becoming suddenly expanded by the heat of the said fluids, or liquids, pass underneath the lower edges of the said inverted chambers, into the adjoining chambers, and pass off through holes or appertures, provided in the upper parts of the said chambers, and through the superincumbent fluids, or liquids, loaded with the aqueous or other vapours; and upon these chambers or ventilators being raised or elevated above the surface of the said fluids or liquids, they again become filled with fresh air, and which is also, in its turn, conveyed beneath the surface of the fluids or liquids, by a repetition of the movement of the ventilators; and thus a continual and rapid evaporation of the said fluids or liquids is produced, as, whilst one part of the said ventilators is plunged into the fluids or liquids to be evaporated, the

other part is raised above their surface, and is receiving volumes of fresh air.

I do not mean to claim as my invention any particular forms or shapes of this said apparatus, but to avail myself of any which may be fit and proper for the purpose, and shall vary them according to the description of boilers or other apparatus they are to be applied to; for instance, in the evaporation of brine in salt-works, in flat-bottomed pans, I shall employ it in either of the forms shewn in the annexed drawing.

Description of the Drawing.

Fig. 1, is a side-elevation;

Fig. 2, an end-section; and

Fig. 3, a plan of a salt-pan, fitted up with one of my ventilators. A, B, in all the figures, is the pan, which is either to be set or mounted in brick-work, as usual, with the fire or fires underneath it, or be heated in any other manner. C, C, in fig. 2, indicate the height of the brim. D, represents the ventilators, or movable inverted chambers, one part of them being shewn by dotted lines, as plunged beneath the surface of the brine; whilst the other part is shewn as raised above its surface, and receiving air, ready to be plunged into the brine in its turn; the form of them is also shewn in the section, at D*. These ventilators are here shewn as being constructed of iron, and as mounted upon a shaft or axis, F, furnished with proper pivots and bearings. In the said section, D*, G, is one of the inverted chambers, closed at top; but which, in certain cases, may have small pinholes made in it, to relieve any pressure upon the boxes; and H, one provided with holes or apertures, I, along its top part, as is more clearly shewn in the plan, fig. 3, at I, I, I, I, I, I, I, I, I.

Fig. 4, is an end-section of an apparatus, similar to that shewn in fig. 2, excepting that the form of the ventilator differs, in the air-chambers being equally deep in the

centre, and on each side of it, instead of their being deeper on each side than in the centre, as in fig. 2. The same letters of reference indicate the similar parts in both figs. 2 and 4; and as well, also, in figs. 1 and 3, and the other figures. Instead of forming the ventilators of portions of cylinders, I can also make them of entire cylinders, mounted upon proper shafts, with pivots and bearings, and as shewn in a side elevation at fig. 5; and in a plan thereof at fig. 6; the holes for the escape of the air, I, I, &c., being also here in the interior or hollow part of the said cylinders, as in the ventilators above-mentioned; and I can either place them at regular intervals across the pan, as shewn in figs. 5 and 6; or lengthwise, as in figs. 1 and 3; and either cause them to vibrate, or to revolve continually, as may be found convenient. And instead of making the ventilators cylindrical, or portions of cylinders, or other curves; I can also form them in a flat shape, and, as shewn in plan, at fig. 7, and in a section, at fig. 8, taken at the dotted line, J, J, in fig. 7; fig. 9, being a cross-section, taken at the dotted line, K, K, in fig. 7; and cause them to be raised and lowered in a vertical position, by any proper machinery, which need not be described here. I can also make the flat-shaped ventilators of a round, oval, or other form. As well as of the square form here shewn, as occasion may require; and, instead of using iron, as above-mentioned, I can employ any other metal, or mixture of metals, or wood, or, indeed, any fit and proper material or materials, according to the nature or purpose to which they may be applied; as for instance, in the evaporation and concentration of brine, solutions of salts, medical extract, salt-petre, and alum works, in the manufacture of sulphuric acid, oxalic acid, the acetates of soda, and lime, and other similar purposes; also in the distillation of acetic and pyroligneous acid, and of ardent spirits; and in the concentration of weak wines, cyder, and perry;

likewise in the cooling, by evaporation, of brewers', distillers', and vinegar makers' worts or wash; also in glue and soap-making, colour-making, and, indeed, in all cases, where evaporation forms an essential part of the process or processes: and I can also employ them in the generation of steam in closed vessels, or in vessels partly closed; my claim being for the conveying air beneath the surface of fluids, not by blowing, as heretofore done, but by means of the ventilators, or inverted chambers, herein described, and displacing the fluids or liquids; and which said air escapes through the apertures made in the upper parts of the said chambers, loaded with the aqueous or other vapours, and also passes through the superincumbent fluids or liquids, thereby greatly promoting the rapid evaporation of such fluids or liquids, and also cooling the said fluids or liquids, according to the well-known effects of evaporation.

In the case of generating steam, in low-pressure boilers, I can employ the vibrating ventilators, D, D, in the manner shewn in fig. 10, which is an end-section of such a boiler, one of them being immersed in the water and the other elevated above it, or employ a revolving ventilator in a similar way to that shewn in fig. 11, which is an end-view and section, and fig. 12, a longitudinal view and section of a revolving ventilator, D, as applied to a still, in order to promote evaporation therein. And it is also evident, that either the vibrating or the revolving ventilators may be employed in generating high-pressure steam, in boilers made of proper forms and strength; in cases however, where the ventilators are to be employed in stills or steam-boilers, it will be necessary that their shafts or axes be made cylindrical, and be passed through stuffing-boxes, to prevent the escape of vapour or steam thereby; and that where cooling is to be performed, the operation may be effected in the usual open vats, or other vessels, commonly employed; the air

introduced by the ventilators, producing its well-known cooling effect by evaporation.—In witness whereof, &c.

Enrolled February 24, 1834.

Specification of the Patent granted to James Windeyer Lewty *of Lichfield Street, Birmingham, in the County of Warwick, Brass Founder, for certain Improvements in Castors.*—Sealed October 5, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said James Windeyer Lewty, do hereby declare the nature of my invention and the manner in which the same is to be performed are fully described and ascertained, in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

Description of the Drawing.

Fig. 1, in the annexed drawing, represents a castor constructed according to my improvements; and

Fig. 2, is a section of fig. 1, whereby the internal arrangement may be more clearly seen. In each of these figures the same letters refer to the same parts, *a*, being the ordinary socket or part to be attached to the furniture. *b*, is a cylinder which descends from, and is attached by, brazing or otherwise, to the socket, *a;* and it is by means of this cylinder, *b*, that the weight and strain on the castor is more securely supported, at the same time the castor is capable of turning with facility. The cylinder, *b*, descends into and turns within the socket, *c*, formed in the horn or lower part of the castor; these parts are accurately fitted to each other. *d*, is a pin or axis passing up through the horn or lower part, *c*, of the

castor, through the cylinder, *b*, the end, *g*, being hammered down or riveted within the socket, *a*, as shewn in fig. 2; *h*, being a washer or ring of metal between the bottom of the socket, *a*, and the riveted head, *g*, of the pin or axis, *d*, as will be clearly seen on inspecting this figure. *e*, is an enlargement of the pin or axis, *d*, fitting into an opening formed at the bottom of the socket, *c*, and *f*, is a projecting head formed on the lower part of the pin or axis, *d*.

Having now described the manner of constructing a castor, according to my invention, I would have it understood that I lay no claim to those parts of castors which are already known and in use; but what I claim as my invention is, the application of the cylinder, *b*, to the socket (or part to be attached to the furniture) *a*, having a pin or axis, *d*, *e*, *f*, *g*, passing through it to turn on, and at the same time retain the parts together, as above shewn, by which castors will be greatly improved in strength and durability.—In witness whereof, &c.

Enrolled April 5, 1834.

Specification of the Patent granted to ALEXANDER STOCKER, *and* WILLIAM SOUTHWOOD STOCKER, *both of the Union Rolling-Mills, Birmingham, in the County of Warwick, Machinists, for various Improvements in Machinery for Manufacturing Iron and other Metal Tips, for the Heels and Toes of Shoes, Chain Links, and other articles.*—Sealed October 22, 1832.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, we, the said Alexander Stocker and William Southwood Stocker, do hereby declare that the nature of our said invention and the manner in which the same is to be per-

Stocker's Patent

Fig 1

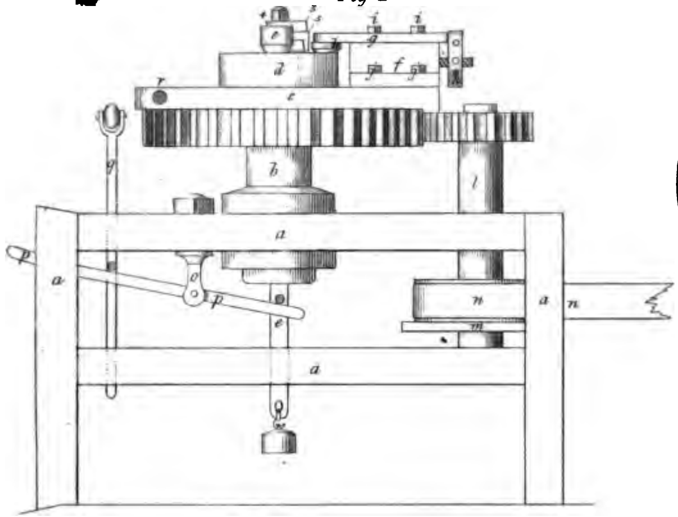


Fig 3

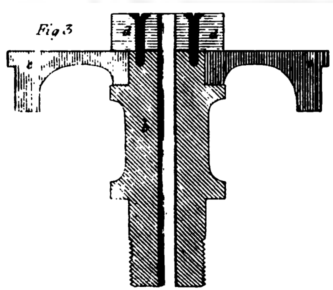


Fig 4

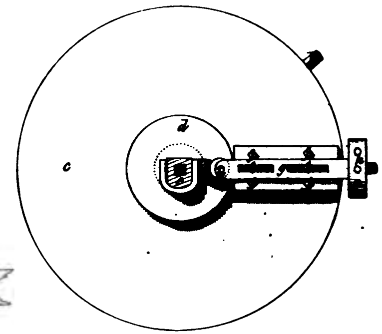
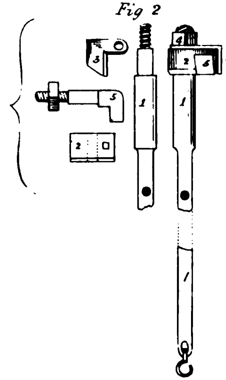


Fig 2



Lewty's Patent

Fig 1.

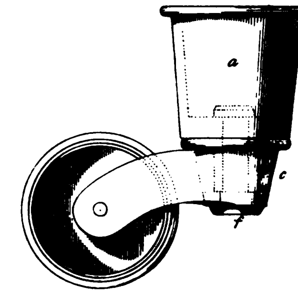
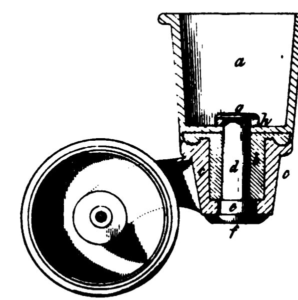


Fig 2.



London . Simpkin & Marshall. for the Proprietor. Aug. 1. 1834.

formed is described and ascertained, as follows (that is to say):

Our improved machinery for manufacturing iron and other metal tips for the heels and toes of shoes, chain-links, and other articles, to the formation of which it will be found applicable, is fully illustrated and explained by means of the accompanying drawings and the explanation of the several parts, and the uses thereof.

Description of the Drawing.

Fig. 1, represents a side-view of a machine.

Fig. 2, represents certain parts of the machine, both connected and distinct, more clearly than could be seen in fig. 1. And fig. 3, represents a sectional view of part of the machine, for the more clear illustration thereof.

Fig. 1. *a*, is a strong frame of wood, or other suitable material. *b*, a strong hollow axis or support. *c*, a strong wheel and disc. *d*, a circular bed or platform. *e*, a templet or mould for giving the required form to the article to be made. *f*, a strong piece of metal, or other material, attached to the wheel and disc, *c*. *g*, a guide-piece for carrying the roller, *h*, round the templet or mould. *h*, a roller moving freely on a pin, which is part of the guide-piece, *g*. *i*, screws for fixing the guides, *g*, to the part *f*. *j*, screws for fixing the piece, *f*, to the wheel and disc. *k*, a nut and screw for adjusting the position of the guide, *g*, and roller, *h*, previous to fixing them by the screws, *i*. *l*, an axis and pinion for communicating motion to the wheel and disc, *c*. *m*, a drum or pulley attached to the axis, *l*. *n*, a band or strap for communicating motion to the machine, from a steam-engine or other power. *o*, a strong fulcrum attached to the frame, *a*. *p*, a leaver moving on the fulcrum, *o*, and serving to raise (when required) the templet or mould, *e*, from the bed or platform, *d*. *q*, a vertical shaft with a friction-roller at its upper end, and a strong projecting-

pin (conveniently situated) on the shaft, for depressing the long end of the lever, *p*, and thereby raising the templet or mould, *e*. *r*, a strong piece projecting from the wheel and disc, which serves to depress the shaft, *q*, and thereby raise the templet or mould, *e*, at a convenient point in each revolution of the wheel and disc, *c*.

In fig. 2,—1, is a long piece of iron, to which other pieces are attached, and by means of which they are also adapted to the machine of which they form an important part. This shaft is properly fitted into a square hole, which passes through the support, *b*, (figs. 1 and 3) and is held down in its place by a weight hung to the lower end thereof. 2, is the templet or mould (denoted by *e*, fig. 1,) through a square hole in which the shaft, 1, passes. 3, is a guide or stop-piece, also fitted on the shaft. 4, is a nut fastening the pieces 1, 2, and 3, firmly together. 5, is a staple, or holder, passing through the mould, and held in its place by a nut in the opposite side thereof.

Fig. 3, is a sectional view of the parts *b*, *c*, and *d*, shewing the manner in which they are connected, and in which the wheel, *c*, carrying with it the parts attached thereto, revolves round the fixed support, *b*, and the templet or mould, *e*. The parts are denoted by the same letters in each figure.

Fig. 4, represents a plan of the upper surface of the machine, with a section of a mould or templet for forming a heel-tip for a shoe, for enabling us more fully to explain our invention, and the manner in which it is to be applied.

The various articles, to the formation of which our machinery will be found applicable, require similar suitable adjustments thereof, an explanation of the manner in which shoe-heel tips are formed thereby, will consequently illustrate its use generally. The material of which articles are required to be made, being cut in suitable lengths, is bent or formed by pressure against

a mould or templet of suitable shape or figure, and this is effected by the roller, *h*, carried round by the wheel, *c*.

In the plan, fig. 4, the dotted straight lines denote the position of the material before being bent into form; the dotted ring denotes the circle described by the edge of the roller, *h*, in its revolution round the mould; and it will be evident from an inspection of the plan, that one end of the material being confined by the staple and the stop (5 and 3, fig. 2,) and the roller, *h*, in its revolution, coming in contact with the material, it will be bent or deflected from a straight line and caused to assume the figure of the mould or templet. In some articles (as in these tips) the ends of the material, when formed against the templet or mould, approach nearer together than other parts of the curve or figure, and therefore could not, without further contrivance, be drawn or released from the mould; in such instances, to effect this important operation, as soon as the formation of the article has been effected, the projecting-piece, *r*, in passing the shaft, *q*, depresses it, and thereby raises the parts shewn in fig. 2. When the piece to which they are attached (1, fig. 2,) being of less dimensions than the mould, allows of the article being withdrawn, and the weight at the bottom of the piece to which the mould is attached, causing it forthwith to descend again, the operation may be repeated without loss of time. When the shape of the article does not require the mould to be raised in order to effect its release therefrom, the vertical shaft, *q*, may be removed from the machine. It is important to observe, that the centre of the mould or templet does not coincide with the centre of the circle described by the roller, *h*, the mould requiring to be fixed in such a position that the roller may pass the staple or holder (5, fig. 2,) which projects from the mould, and after bringing the material into contact with the mould about the centre of the curve, complete the operation by urging the extremity also into close contact therewith.

A part of our invention consists in making the surface of the bed or platform *d*, convex, concave, or of such other form as may contribute to give the desired shape to the articles to be formed by the machine in the formation of shoe heel-tips (by which we endeavour fully to explain our invention and the application thereof) the bed or platform is made slightly convex, which causes the outer edge of the tip to fit close to the leather of the shoe heels, thereby producing a better article than if such a circumstance had been disregarded.

And we further declare, that we cause the edge of the roller, *h*, to be made of such a form as will cause it to contribute most effectively to the formation of any article by urging it against the mould or templet, *e*, and also against the bed or platform, *d*.

We do not claim any exclusive right to the invention or the use of such parts as the wheel, *c*, the axis and pinion, *b*, or the roller, *h*, but to such a combination and application of them as is necessary to constitute the particular machine which we have described, and of which we are the inventors.—In witness whereof, &c.

Enrolled April 22, 1833.

Specification of the Patent granted to JOHN PAUL NEUMANN, *of Cornhill, in the City of London, Merchant, for certain Improvements in making or producing Leather from Hides and other Skins.*—Sealed December 21, 1833.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said John Paul Neumann, do hereby declare that the nature of the said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following description thereof (that is to say):

The novelty and utility of the new invention communicated to me by a certain foreigner residing abroad, consist in employing the hop-plant, whether root, stalks, or leaves, or any part thereof, either in a green or dry state; but I prefer the use of the plant in a dry state, and for the sake of economy I give the preference to the stalks and the roots; but be it understood, although I prefer the hop-plant, or any part thereof, to be used by itself for the purpose of tanning, yet they may be used in conjunction with any vegetable containing tanning matter. The mode to which I give the preference for this plant to be used for the purpose of tanning, is, to grind or reduce it as fine as practicable, and when so prepared, it may be employed for every mode of tanning in the same manner as oak bark, or any other vegetable containing tanning matter. According to circumstances of different hides or skins, this tanning matter may be applied either warm or cold, whether in extract or mixed with other matter; every practitioner in tanning will soon perceive which mode is most applicable for the different hides or skins which he means to subject to the process of tanning, as hides and skins require different modes of treatment; with some it is necessary to use heat or warmth, and others cold; but I prefer to have the hides or skins prepared in the usual mode hitherto followed by practical tanners.

The principal novelty of this invention consists in using the hop-plant for tanning, which hitherto has never been employed for that purpose; and by means of this process it will be rendered both useful and valuable for the purpose of tanning.—In witness whereof, &c.

Enrolled June 20, 1833.

LAW REPORTS OF PATENT CASES.

Court of Exchequer, Guildhall, July 5, 1834, before Mr. Baron Alderson, and a Special Jury.

MINTER *v.* WELLS AND ANOTHER.

Mr. Evans opened the pleadings.

Mr. Pollock addressed the jury for the plaintiff. The action was brought by the plaintiff, a chair maker, against the defendants, who are persons in the same line of business, for an infringement of a patent taken out by plaintiff in 1830.* The chair made by defendants, would be seen by the models to be merely a close imitation, with such alterations as may always be made in a mechanical invention, the sole object being to participate in the fruits of the patent, they not having the slightest claim to share in it. The learned counsel observed, that actions upon this subject have of late been rather more frequent than they were formerly. There was a time when a patent was considered a monopoly, and a monopoly was, from very ancient times, considered something very odious, and therefore there was a general feeling that a patent was to be watched with extreme strictness, that unless in all its parts,—its title, its specification, and so on,—it was perfect and free from objection, it would not stand the test of inquiry in a court of justice. Going back some few years, probably it will be found, that the majority of actions for patents have failed. A different view has prevailed in modern times; and it is a matter not of regret, but of congratulation, that generally, in modern times, actions of this sort have succeeded. Juries have been told to address their good sense to the subject, neither to look with peculiar strictness on the one hand, nor relaxation on the other; but addressing their experience, knowledge, justice, and impartiality to the subject, fairly to decide whether the act that is challenged

* For Specification, see Repertory, vol. xii. (third series) page 68.

as an infringement, be an old or new invention, or whether it be a copy, possibly a servile copy of the invention in question.

The learned counsel then described from models the two chairs, the plaintiff's and defendants'. The object of plaintiff's is to obtain a mode of connecting the seat and back of the chair, in such manner as to enable a person sitting, by a simple effort of the back, to throw it back and have a reclining couch, which may again, by a very little pressure, be restored to the original position, or kept in any intermediate position, not only without the slightest inconvenience, but to the great comfort and relief of the party sitting in the chair. There are persons who suffer under bodily infirmity, to whom a chair of this description is matter of infinite importance; to whom the power of varying the position with a very slight effort is a matter of the utmost importance. Persons eminently qualified to judge, from their having devoted themselves for many years to all the improvements of the day, will prove this, as an invention, is new, and as an improvement almost perfect. The back of the chair plays upon axles or points, and, as it turns, there is a part underneath which lifts up the seat, and inclined plane, working upon part of the chair, causes the seat to rise, the effect of such inclined plane being, that the moment you give the slightest pressure the other way it comes back again; and but for this inclined plane the effect would not take place. The arrangement of the parts adapted to each other in this way, is what produces the effect. The title of the patent is "An improvement in the constructing, making, or manufacturing of chairs, which," the inventor says, "I intend to denominate Minter's Patent Reclining Chair." After describing the general object of it, he says, "My invention consists in the application of a self-adjusting leverage to the back and seat of a chair, whereby the weight on the seat acts as a counter-balance against the back of such chair, and

whereby a person sitting or reclining in such chair, may, by pressing against the back, cause it to take any inclination, and yet at the same time the back of the chair shall, in whatever position it is placed, offer sufficient resistance and give proper support to the person so sitting or reclining in such chair." Then there is a description of the separate parts. What he claims as his invention is this self-adjusting leverage as described and set forth in the specification.

Plaintiff sold an immense quantity of these chairs; some hundreds within one year: a proof of the value of the invention, and of the profit it was calculated to give the inventor. Defendants thought they could produce something of the same description, which they would say was as good as Minter's and yet not an infringement of his patent. There is an old sort of chair, in which there is a back with a hinge to it at the bottom, where a party may sit with his back to the wall, and by moving the seat at certain distances you may obtain all sorts of positions for the back and legs: but there is no self-adjusting leverage in that. Then there is a chain where you may let yourself down and wind yourself up again. Then there are what are called bed chairs; the back falls or rises by a winch, or by a series of notches; but this is nothing like plaintiff's. The defendants have merely placed the inclined plane, which is in the back in plaintiff's chair, at the front instead of at the back; just the seat taken and turned. This is not so good as the plaintiff's chair; but a man has no right to pretend to invent something that is a spoiling of the original patent; it is taking it without a right to it, and making it worse. The question is, whether defendants would have invented the chair which they profess to be their's unless they had seen this, and observed the demand for it. Both plaintiff's and defendants' processes operate to produce the same effect; the inclined plane raises the seat and gives the power; because it is on the inclined plane that the

weight is so placed as to be in a state of equilibrium, until some sort of impulse is given. If defendants would make their chairs without that inclined plane, they might make them to the end of time; nobody would use them, for if the seat be perfectly straight the chair will not move; it is entirely because the weight is put on the inclined plane that the party has the power of moving up or down. The identity of the two is ascertained without any difficulty. Each has a back playing in the same manner, each has a seat rising on an inclined plane, with a hinge, and capable of moving. As well might a person who had made an invention of great merit, in which one form of mechanical device was used for another, come in and use another, there being certain matters known among mechanics, mechanical equivalents: just as well might a person say, "Why you use a lever and I a screw;" or, "You use a plane and I a screw;" and then say, "I have the full benefit of your invention, because I have substituted for a lever a screw, or some other known mechanical mode of doing the same thing."

The learned counsel then described the action of the two chairs from models and a skeleton of the chairs; pointing out the similarity of the two, and also the superiority of plaintiff's to the defendants'.

The learned counsel then proceeded:—Defendants have attempted to obtain the benefits of the invention simply by varying some of its parts. There was a case similar to this: Forsyth's patent was taken out for the use of detonating powder in the discharge of fire arms; there was a hammer that came down and struck the pan, containing a small portion of detonating powder, which by the impact exploded and the. piece fired. A gun-maker, perceiving the value of the discovery, invented what he called another mode of applying the detonating powder; saying, "You cannot have a patent for a principle; for merely using detonating powder for fire arms." He put the powder on the hammer, so that when the hammer came

down it knocked the powder and fired the piece. The learned lord who presided, said, "This is nothing, but, instead of bringing the hammer to the anvil, it is very clumsily bringing the anvil to the hammer." The same remark will apply to this case. Any person who will take the trouble of considering the two chairs, will see that the one is a servile copy of the other, with that degree of non-resemblance that shall operate to mislead the public, and deprive the patentee of his just rights.

It may be said that Mr. Minter is not the first inventor of this chair. But no one had anything to do with it, except a workman formerly in Mr. Minter's employ; they worked together, and brought the invention to perfection. Mr. Minter took out the patent, and his workman, who must have been considerably trusted, had a reward given him, by an instrument under the hand and seal of both parties, in which he receives compensation for his secrecy during the progress of the invention; but, under the hand and seal of that man, Mr. Minter is pronounced the inventor. Nothing would be so monstrous in point of injustice to an individual, and unsafe with respect to the rights of the public at large, on the subject of patents, if a man employed during the progress of bringing a discovery to perfection was to be allowed to come in afterwards and say, in spite of his hand and seal to the contrary, "Why, the invention is one part mine; Mr. Minter is not the whole and sole inventor." If such were the case, there would be an end to all the security with which the rights of the public are respected.

Witnesses were then sworn and examined as to the purchase of the chair from Messrs. Wells and Hart, and also the quantity sold by the plaintiff.

Mr. Pollock intimated that plaintiff did not go for damages, but only to try the validity of the patent.

Mr. John Farey, sworn, examined by *Mr. Pollock*.—Has been a civil engineer for twenty-eight years, during nearly the whole of which time he has directed his atten-

tion to the subject of patents; has read plaintiff's specification, and has seen his chair. The mode of arranging the chair is new, inasmuch as that the weight which bears upon the seat regulates the inclination of the back, balancing the pressure which the back of the person exerts against the back of the chair, by the pressure which the lower part of the body exerts on the seat of the chair. The reclining chairs, previously to this, always required some other manipulation to cause them to incline, some ratchet, catch, or screw to retain them at that inclination that was given to them. Has heard of a chair with springs. Has tried several easy chairs, but never found one satisfactory before plaintiff's. Witness suffers under a complaint that makes a chair of that sort a matter of importance, and has found plaintiff's chair a very great accommodation. The specification of plaintiff is fully sufficient. Has seen the chair made by defendants, and considers it decidedly an imitation. The effect obtained by the self-adjusting leverage is precisely the same; the self-adjusting leverage is composed of the same parts, the difference is only in the relative position of some of its parts, the operation of the self-adjusting leverage being precisely identical in each chair; the pressure on the seat counterbalances the pressure on the back in all positions; the principle is the same in each. Has seen the skeleton of the two chairs produced, and considers it a correct representation. The defendants' chair is a very close imitation of plaintiff's. The inclined curve (should call it an inclined curve rather than inclined plane) is the same in both. The great merit of the chair, is, that it is not in a state of equilibrium at one point only, but at all points, and at all times; and also that it actually assists and supports any effort that is made to alter the position; and during the time of altering the position, the chair assists and supports the person in that act, and retains it wherever that effort ceases. The difference of position given to the inclined plane occasions some in-

convenience in defendants' chair, which is not found in plaintiff's; it projects the seat forward, and does not so well conform to the curvature the body takes; it raises it only by virtue of the action of the lever in the arc of a circle; whereas plaintiff's combines that with the action of the inclined curve.

Cross-examined by *Mr. Serjeant Talfourd.* — The principle of action in these chairs is not an old and well-known principle: never saw chairs before to which this principle has been applied. Never saw a seat made by a person of the name of Sutton. There are no such iron plates as is described in plaintiff's specification in defendants' chair; the back of the seat is hinged to the bottom rail of the back of the chair; there must be a cross-rail at the bottom of the back, or nothing could be applied. In defendants' chair inclined curves are used; they are slightly curved; the straight line would do in either case imperfectly. Defendants' chair is hinged in front, and is not capable of being advanced forward, the front of the seat conforming always with the front of the chair. The defendants' chair placed in the most reclining position is not so much in a recumbent position as plaintiff's, the sitter is more in a recumbent position in plaintiff's than in defendants' chair. In the patent chair the foot-rest can be supported by the solid frame of the chair beneath; but in the other, where the seat is moveable, it requires the foot-rest to be attached to the seat, which is not at all able to bear the weight of it.

Mr. W. Baunton, sworn, examined by *Mr. Evans.*— Has heard the evidence of Mr. Farey, and has examined both chairs, and agrees with Mr. Farey in that evidence. Has been an engineer between thirty and forty years, and has been much conversant with patents. Never knew such a chair as plaintiff's before his came out; considers it quite a new invention.

Cross-examined by *Mr. Godson.* — Never heard of Sutton's chair. Has had occasion to look at chairs of

various descriptions, but never saw one with the self-acting principle before plaintiff's. (The learned counsel handed to the witness a model of a chair said to be Sutton's). This is not on a self-acting leverage principle; there is no adjustment of balancing here: if a person were to get up entirely from the chair, and put the chair in the position, and sit down, it would stop there; but you could not do it yourself without great exertion: an active man might do it, but a sick man could not. This chair and plaintiff's are not alike.

Re-examined by *Mr. Pollock.*—According to the construction of plaintiff's chair in whatever position you put it it will remain there till some force is used to alter it; this is not the case with the chair produced by Mr. Godson; there is no principle applied to adjust the weight of the back and the weight of the seat in different positions, so as to produce that equilibrium.

Mr. Farey again examined by *Mr. Pollock.*—Is perfectly well acquainted with the chair produced by Mr. Godson, but did not know it by the name of Sutton, having made trial of one: there is no self-adjusting leverage in it, nor any leverage whatever; in the model produced there is a leverage. The knobs behind, in the model, produce a leverage; but there were no knobs in the chair witness used, the seat never rises at all, which is peculiarly uncomfortable, that you always sit in a horizontal seat when you want an inclined plane.

Mr. W. Carpmael, examined by *Mr. Rotch.*—Is an engineer, has been in practice about nine years. The self-adjusting leverage in plaintiff's chair is produced by the inclined plane in conjunction with the parts, *h, h.* In the one instance the under parts marked *h, h* (in the plaintiff's specification), pass along the inclined curves marked, *i, i*: in the other instance (the defendants') the inclined planes or curves pass over the front rail of the chair. If you approach the point of support of the seat of the chair along the inclined curves, the seat has always a capa-

bility of returning. It is the travelling along of the point of support, *h, h,* under the inclined curves in the plaintiff's chair, and the passing of the curves over the front rail of defendants' chair which produce respectively the self-adjusting leverage. Believes Mr. Minter's invention to be new; specified a patent chair for Mr. Daws about 1826, and then had occasion to inquire what had been done before in easy chairs: has since been engaged for others, but never met with anything approaching to the plaintiff's invention, before plaintiff's patent.

Cross-examined by *Mr. Serjeant Talfourd.*—Has been an advising engineer for the last nine years, and extensively engaged in patents and specifications.

Re-examined by *Mr. Pollock.*—Was applied to by the solicitor to attend as a witness for the defendants', just after the action commenced, but declined to attend in their behalf. The great peculiarity in defendant's chair is that it at all times gives support to the body in every position of the chair. This effect is protion of the back and seat of the chair, which is not to be found any where but in plaintiff's and defendants' duced by the inclined curves or planes, and the combinachairs. The plates, *h, h,* mentioned in plaintiff's specification are not common to any other chair but plaintiff's.

Mr. Richardson, examined by *Mr. Evans.*—Is an upholsterer in Holborn. Has been in the trade from infancy; has sold Mr. Minter's chairs; never saw one of that description before 1830; considers it a new invention. Has seen the chair called Sutton's; did not know it by that name before; never sold any of them. Has had some of said chairs, but not with knobs at the back.

Mr. Serjeant Talfourd here called his lordship's attention to the terms of the specification as compared with the evidence given by the witnesses, with respect to the means by which the effect in plaintiff's chair is produced, and contended that there was nothing in the specification which can apply to the evidence given. According to

the testimony of all the witnesses, the effect is produced by the self-acting leverage or the inclined plane: and in the specification it is attributed to something else—the iron plates at the back of the chair. The first claim which the plaintiff makes is in these terms: "My invention consists in the application of a self-adjusting leverage to the back or seat of a chair," &c. That is, the description of the effect and result produced by the invention. Then, having described the plates, *g*, *g*, *h*, *h*, the plaintiff goes on to say, "It is the application of these plates, *g*, *g*, *h*, *h*, by which the object of my invention is obtained." According to the evidence of the witnesses, it is by the operation of inclined planes that the end is obtained. Plaintiff could not have a patent for that sort of divided lever—a bent lever, by which the action of one part of the body would form a counter-balance to the weight of the other part. It is the means by which he does that for which he seeks this patent. The circumstances which he points out as being the means is not the inclined plane, but the iron plates fixed at the bottom of the chair.

Mr. Baron Alderson requested the learned counsel to read the paragraph to the end, and then no such construction could be put on the specification. After some further conversation with Mr. Serjeant Talfourd and Mr. Godson, his lordship observed, If you can shew ultimately that chairs had been before constructed with a self-adjusting leverage, you will certainly then shew that the plaintiff has claimed more than he is entitled to.

Mr. Serjeant Talfourd then addressed the jury for the defendants.—He agreed with his lordship, that it is much better to come at once to that which is the real point in the case, throwing overboard all the rest, about which there can be no difference of opinion. The case now resolved itself into some very simple points upon which the jury would have to hear some evidence on the part of the defendants. He entirely agreed with his learned friend, that the views taken at the present time of meritorious

inventions are much more correct than formerly, when actions for patents scarcely, if ever, succeeded; but he hoped there was not to be a run upon that colour; because they were brought into a certain channel of success, which the learned counsel had been in the habit of achieving for patentees, but that the case would be looked at candidly according to its merits. The two questions for the jury to consider were, whether the plaintiff is or is not the inventor of anything new; and, in the next place, whether he is the *boná fide* inventor, or whether another person invented it. Another question will be, whether defendants have infringed that patent. Is the plaintiff claiming some principle applied to chairs, never applied before, or is he claiming in respect of certain minute combinations and circumstances, which render the operation of that principle more perfect and complete? Is he to succeed by reason of saying that he is the first person who ever adopted the principle of a self-adjusting leverage in the manner described? There will be no difficulty in shewing that the principle of a bent lever as applied to chairs was very well known before Mr. Minter took out his patent. It will be shewn, by the evidence of Sutton, that that principle, although not so perfect, was known, and actually applied, by him at a time long antecedently to the period of plaintiff's patent. In plaintiff's specification in which he is bound to disclose, not only the result at which he has arrived, but the means by which his end is to be obtained, he points to a circumstance that does not at all exist in the chair as manufactured by the defendants, namely the iron plates which work in grooves in conjunction, not with inclined planes, but curved pieces of wood above them, and thus render more perfect the action of the self-adjusting leverage. The means in defendants' chair is not a mere reversion; but the adoption of different means for the purpose of producing the result: it is produced by the working of the inclined planes on wedges, they work one upon the other, so that the operation is regulated.

Now the effect of that is, whether better or worse is of no importance at all, decidedly different from the effect produced by plaintiff's. In the plaintiff's the seat is confined in front, it is not capable of making any advance; the charge is produced by raising up the back of the seat, and by raising up the lower part of the person of the sitter, and so placing him in a situation of comfort. On the other hand, defendants' chair being hinged at the back is projected in front, beyond the frame work, so as to bring the sides almost, if not quite, into a recumbent position. The plaintiff's is properly speaking a reclining chair, and defendants' a recumbent.

Those who might like to use plaintiff's and those who would use defendants' would be quite different persons, requiring different results. Whether they are better or worse, the one is quite different to the other, and different classes of purchasers would buy them respectively. Therefore defendants' have done nothing which can interfere with the sale of plaintiff's.

Then there is another question; if this chair be altogether new, if Mr. Minter be not the real and true inventor, but that it had been invented by an ingenious man in humbler circumstances than himself, he has no right to sustain his patent. If the individual whose name will be introduced, is a man of the name of Lutton, was a workman in plaintiff's employ, working under his direction in his manufactory, then it is impossible to contend that he is not properly and fairly speaking, entitled to be considered the inventor. But Mr. Minter had nothing at all to do with it; although he did afterwards take Lutton into his employ, had no relation at all with him at the time when he made this invention. Lutton was a man in humbler circumstances than Mr. Minter, and was working at that time for himself, and had studied the mechanism attached to chairs, and made one precisely of the description as that claimed by plaintiff. The persons who made the various parts of the chair for Lutton will be

called. Lutton went about to various persons to advance him money for the purpose of obtaining a patent. The learned counsel (Mr. Pollock) has referred to some agreement or arrangement which took place between Mr. Lutton and Mr. Minter at a subsequent period; but that being the property of Mr. Minter, it rests with him whether it is to be produced; but if it be, it will be seen that the terms of the contract are altogether inconsistent with any other notion than that plaintiff knew Lutton was the real inventor. The principle on which a patent is granted is, as a reward to a person who, by his own wit or genius, invents that which is a benefit to his fellow-men; and a person must make oath that he is the inventor himself: the question is, whether that which was sworn by plaintiff on this occasion was really true, whether he or Lutton was the inventor of the chair. Lutton will not be produced, but only the persons who made the chair for him, without any intervention on the part of Mr. Minter.

Mr. Baron Alderson.—It will not signify a farthing who invented it, if you shew the fact. That was Mr. Donkin's case, the case of the introduction of the patent paper manufacture. Mr. Donkin proved that he was employed by Fourdrinier, and he suggested two or three improvements, and a patent was taken out.

Mr. Pollock.—I need not remind you lordship of Dollond's case.

Mr. Baron Alderson.—That was a case not brought into practice. There was the case from America of the Rotatory Cutting Machine.

Frederick Tompkinson, examined by *Mr. Godson.*—Is a chair-maker; knew Lutton by sight in 1830; he was a chair-maker. Lutton was making chairs on his own premises in March, 1830, exactly similar to plaintiff's; with iron plates and a fulcrum, fastened in front and behind exactly similar. Saw about a dozen or more chairs of that sort. Several men were employed by Lutton.

Cross-examined by *Mr. Pollock.*—Was apprentice at

the time; went to see a shopmate who worked at Lutton's, and there saw the chairs. Does not know what became of them; saw them last last June four years; has made the same chairs himself for an upholsterer, about twelve months since The action of the chair he saw at Lutton's was this: there was a circle on the back of the seat; the back was poised so that the counteraction of the seat should act against the back. Did not see any of these chairs in a condition to be sold. Does not know who Lutton was making them for; has heard that he since worked for Mr. Minter. Knew Lutton four years ago; at that time he kept a manufactory in Dean Street, and worked for the trade. Had not been requested to be a witness, but had come voluntarily that morning, hearing that a trial was to take place. Has made chairs exactly according to the patent chair without the leave of the plaintiff.

His lordship here remarked that the witness, having infringed the patent, was liable to an action, and this might account for his being a volunteer.

Re-examined by *Mr. Godson.*—The chair-maker, in general, does nothing more than the wood work, except put on the castors. The chairs at Lutton's were so far finished as a chair-maker would have to do with them; they were finished as far as the acting principle was concerned.

John Highley is a smith; knows Lutton; was employed by him in September 25th, 1830, to make iron plates, exactly like those in the model; they were intended for chairs; has seen them after they were put together, three or four years ago. When he made the plates first, Lutton lived in Wells Street, but afterwards in Dean Street.

Cross-examined by *Mr. Pollock.*—Saw the plates in Dean Street; Lutton moved from Wells Street to Dean Street; he was in Wells Street when the first irons were made; did not see any chairs finished until two or three

months after the irons were made. Had worked for Lutton long before that time, and had made iron work for him, but none of the same sort until September 25th, 1830. Mr. Minter's name was on the door in Dean Street, but not in Wells Street.

Charles Wilson is a baker in Wells Street. Lutton occupied a back shop of witness, down to June or September quarter, 1831. Lutton shewed him a chair in 1830, in the back shop in Wells Street; it was a reclining chair acting by balances; it was similar to that produced as plaintiff's.

Cross-examined by *Mr. Pollock.*—There was a party in the habit of coming, at the lattér part of the time, on Sunday; was informed it was Mr. Minter; he used to come on Sunday, and was closetted with Lutton, when the workmen were away. At that time Lutton worked for the trade.

Re-examined by *Mr. Serjeant Talfourd.*—Only one came on the Sunday; cannot recognize Mr. Minter.

William Pitt is an engineer. Heard Lutton speak of a reclining chair about the time Mr. Minter took out his patent. The chair Lutton spoke about afterwards was called Mr. Minter's chair. It was about six months between Lutton's speaking to witness about the chair, and shewing the chair.

Charles Handy is a carpenter. Knew Lutton in the year 1829, at the time he was making a patent chair. Advanced Lutton money; has sometimes paid Highley's bills on Lutton's account. Mr. Minter's name was over the door in Dean Street.

Joseph Langdon is a carver in the wood line. Knows Lutton; was employed by him to carve chairs similar to plaintiff's. The chairs were similar to that, but had not that action; the first chairs he made were hinged in the stump; they acted on a hinge on the back leg; he made up a dozen, but did not send them forth to the world. To a man who was not a judge, perhaps he

might say they were the same as these; there were a dozen of them. The concern was parted with to persons of the name of Brown and Yates; the chairs, the invention of the chairs, and every thing else, was sold to Brown and Yates. It might be about twelve months before witness saw plaintiff's chair that he saw the dozen spoken of; they were not balanced; they were hinged and went with a rack under the seat; the sitter balanced himself by means of a wrench and a rack, in the common way.

John Benker.—An upholsterer. Stuffed the back and seat of a chair in September 1830, for the purpose of showing it to Mr. Minter. The chair was exactly like plaintiff's.

Cross-examined by *Mr. Pollock.*—Lutton brought the chair and remained while it was stuffed. It was only stuffed in a temporary way for the purpose of shewing to Mr. Minter. Lutton brought only the back and seat; saw the remainder at Wells Street during its progress. Has never quarrelled particularly with Mr. Minter; called on him about some benches, and he would not give them up, and he (witness) was very much vexed.

Mr. Benjamin Lawrence, attorney for defendants.—At the time this cause was down for trial at the last sittings, Lutton was brought from the Whitecross Street Prison, as a witness on behalf of defendants: since that time he has left the prison; has caused due diligence to be used to discover him, but hitherto without effect.

James Sutton is a chair maker. Made the chair produced; it is his own invention. Began to make those chairs as early as 1830. They had no knobs; but they would act as this does without the knobs.*

Mr. Pollock, in reply, said.—He hardly knew to what topic to address himself. It was said that there was no evidence that Mr. Minter employed Lutton, but was not

* This chair was the same as was shewn to Mr. Farey and Mr. Brunton, who were examined as to its being like that of the Plaintiff.

Mr. Minter's name over the door in Dean Street, according to the testimony of three witnesses. There is no distinct evidence that Lutton was in the service of Mr. Minter; but there is this evidence, that a person of the name of Minter came on the Sunday; and it can easily be judged why Sunday was selected, because the idle boys, and apprentices, and curious workmen would not be about. From Wells Street, Lutton went to Dean Street, and there Mr. Minter's name is over the door.

The first question asked by the learned counsel is, "Is the plaintiff the inventor of anything new?" And Sutton was called to prove that that was his chair, but as his lordship observed, it was a very different chair. The next thing is, "Is defendants' an infringement of plaintiff's patent?" But not one witness that has been called by defendants have been asked that question; can any one have a doubt about it. Then it is said Mr. Minter is not the inventor of it; why was not Lutton brought to prove this? The attorney who was put into the box does not say, "I have tried to get at Lutton;" but "I have caused due diligence to be used." If the absence of Lutton was honest, why did not the learned counsel apply to put off the trial? The absence of Lutton was not *bonâ fide;* for if it had been upon an affidavit stating that he was a material witness whom they had tried to subpœna, and had not been able, his lordship would have instantly postponed the trial. If Lutton had been put into the box he must have told the truth; and it was much better to get round about the thing, to deal in suspicion of what Lutton had said or done, and his whereabouts as to Wells Street and Dean Street, instead of putting him into the box. The trial might have been postponed before one farthing of expense had been incurred. That the plaintiff might take no particular pains to get a man here who might turn his testimony to the best account, is natural enough; but, in the absence of Lutton, what is the evidence you

have to shew that Lutton is kept back by plaintiff? [Here the jury intimated to the learned counsel that he need not proceed.]

Mr. Baron Alderson then summed up. The only question in this case is, in order to establish the right in the plaintiff, they must shew that the invention is new, and that it is useful; and that the specification is such that an ordinary workman could make the machine, which would answer the purpose the patent was intended to accomplish. The patent is *prima facie* evidence on the part of the person who claims the right that he is entitled to it; and it is for the person who seeks to infringe it, to shew some circumstances whereby that right, which otherwise would be presumed to have existed, has been improperly obtained by the plaintiff. He states in his petition, "that he is the true inventor of the machine in question;" if it could be shewn he was not, the Crown is deceived in the suggestion made to it, which was the foundation on which it granted the patent; and then the law is, that a patent obtained under such circumstances would be void, and no action could be maintained against a party for the infringement of the patent, by reason of the suggestion to the Crown not being true. Then that issue would be that that suggestion to the Crown was not true. Now in this case, in order to shew that, they put in, first, the patent. Then you see what it is the plaintiff claims by the specification, which, he says, is the basis of his invention; and he says, by the specification, that his invention consists in this: "in the application of a self-adjusting leverage to the back and seat of a chair, whereby the person sitting or reclining in such chair may, by pressing against the back, cause it to take any inclination, and yet, at the same time, the back of such chair shall, in whatever position it is placed, offer sufficient resistance, and give proper support to the person so sitting or reclining in such chair." Then he goes on to describe the manner in which that

is carried into effect; and he ultimately claims, pretty nearly in the same words, at the end, "My invention is the application of a self-adjusting leverage to the back and seat of a chair, whereby the weight on the seat acts as a counter-balance to the pressure against the back of the chair, as above described." So that the essence of the invention consists in the chair having what he calls a self-adjusting leverage; that is to say, by which the pressure on the seat raises the back, and the pressure against the back raises the seat, and that whatever force of the muscles is applied to disturb the equilibrium, the moment that is taken off the body remains in the position in which it was left. Therefore it seems the essence of the claim to invention, and undoubtedly his claim, is, the application of a self-adjusting leverage to the chair; and if it could be shewn that any self-adjusting leverage had been before the plaintiff's patent applied to a chair, the patent would be void, because the specification claims every species of the application of a self-adjusting leverage to the back and seat of a chair; he would have claimed, not the particular way of accomplishing the particular purpose, by the particular engine, but he would have claimed too much because he would have claimed the application of every such self-adjusting leverage to the back and seat of a chair. Now it is for you to say whether you are satisfied that the species of self-adjusting leverage has ever been applied to the back and seat of a chair before. That would be material in this way, because it would materially affect the second question which you would have to consider, which would be, whether the defendants have infringed the patent. For if there had been a self-adjusting leverage applied before, and the patent had been taken out for the particular mode of accomplishing it in the patent chair, any one else might have applied the same principle in any other way, and that would have been no infringement. But if the plaintiff's patent is for the application of a self-adjusting leverage to the back and

seat of a chair, then it would become a very different question when you come to consider whether the defendants' is an infringement or not.

The first question, therefore, which you will have to consider, is, whether the invention itself is new; that is, whether that which is claimed as the invention of the application of this self-adjusting leverage to the back and seat of a chair, ever existed before. If you are satisfied that it has not at any time existed before, then you will inquire whether it is a useful invention; but about that there seems no reasonable dispute. But if that be new, if it be useful, and if the specification be such as that an ordinary workman could make the machine from the directions given in the specification, it would be a *prima facie* case on the part of the plaintiff. That may be answered by either one of two ways; and that is the way in which they seek to answer it, either by shewing that the invention was not new, which turns upon the question, whether this chair (Sutton's) was made upon the same principle. Secondly, whether you think, that even though the invention was not known, the defendants' have shewn that the plaintiff was not the true and first inventor.

Now I do not know whether you would wish me to go over the evidence of Sutton. (The Jury intimated that such was not their wish.) Then I will call your attention to the other point. The question is, whether Lutton was the true and first inventor; if he was, the plaintiff is not entitled. But the defendant is to make that out—

(The jury intimated they were well satisfied that it had not been proved that Lutton was the first inventor).

Mr. Baron Alderson.—I think so too. The plaintiff must be proved to be the true and first inventor; but the circumstance of his being the first to introduce it is so far *prima faciæ* evidence that he was the true and first inventor. Then the question is, is that negatived by the evidence produced on the part of the defendants. That

evidence comes to this. Tompkinson says, that prior to the invention being patented, the 9th of November, 1830, the date of the patent being taken out, he saw twelve chairs of a similar description to those for which the plaintiff is proved afterwards to have taken out a patent, in Dean Street, four years ago last March, that would be in 1830, and the patent was taken out in November, 1830. If, therefore, he is correct, the plaintiff is not entitled to your verdict, but the defendants. The question will be, however, for you to say, whether you are satisfied that Tompkinson is right, first as to the period of time, when he saw the chairs in question; and, secondly, if he be right in that, whether he be right in saying that the chairs were of a particular description mentioned, the same as plaintiff's chair. The way he describes that is this—"the chair was similar to Mr. Minter's; it had a fulcrum behind; and, in fact, was his chair." He says, "it was like the plaintiff's. I saw a dozen or more of that description on his premises; several men were employed there; I was apprenticed at the time to Mr. Fowler for seven years; I shall have been three years out of my time in December next. Lutton did not apply to me to make any thing; I went to his shop in Dean Street; I saw some chairs; I saw them last time four years ago." He says, "I have seen one of them at Mr. Trevethan's," but it appears that was not the chair in question, but one that he himself made. He says, "I saw one or two of these finished; they were not stuffed; they were not in a condition to be sold; I have been acquainted with Lutton for several years. I do not know who Lutton was working for; he did not keep a shop, he worked for the trade; all were recumbent chairs that I saw." There is no doubt he might have seen twelve recumbent chairs in the state he describes the twelve chairs to have been seen; and yet it is also extremely probable that those recumbent chairs, the same in number and description, were chairs on a different principle, be-

cause we have the testimony of a person of a different description, of the name of Langdon, who says, he remembers the chairs at this place, "that there were twelve chairs; that they were finished, but not stuffed." But when he is examined as to the principle on which these chairs were made, he says, "They were not on the same principle with the chairs in question, but that they were hinged, that they went on a rack behind;" which undoubtedly was the state in which all the gentlemen of science state was the condition at which chairs had arrived previously to the plaintiff's invention. I think, therefore, it is probable, when you weigh the evidence, that Tompkinson is very likely to have seen the twelve chairs in question, which were on a different plan; if he saw them prior to the time of the patent, his seeing them would not prove that there was any chairs like Mr. Minter's in Lutton's possession. He says, "John Chapman was working for Lutton; Chapman is not here nor Lutton." Lutton would be a most important witness, for this reason, that Mr. Minter and Lutton were together about the time the invention took place; which of the two suggested the invention, and which carried it into effect, is a question for you to decide. If Lutton suggested the principle to Mr. Minter, then he would be the inventor; if, on the other hand, Mr. Minter suggested the principle to Lutton, and Lutton was assisting him, then Mr. Minter would be the inventor, and Lutton would be a machine, so to speak, which Mr. Minter uses for the purpose of enabling him to carry his original conception into effect. You will judge which is the more probable of the two. Mr. Minter makes out his *prima facie* case; he is the person who takes out the patent. We do not find that Lutton ever claimed to take out the invention. If Lutton has received a compensation, nothing would have been more simple and easy; if Lutton was the man who took out the patent, still Mr. Minter might have the same benefit to-day, and there is no apparent reason why

Lutton should not have taken out the patent which Mr. Minter has taken out, unless they were both desirous to ruin the invention. For suppose two persons are engaged on an invention of this description, they know perfectly well between themselves who is the real inventor of it, and who is the person to carry into effect the conception; but they would destroy the value of it to both if they did not take it out in the name of the right person. Whatever the probabilities of the case therefore are, you will not leave that entirely out of the question. Then Highley's evidence, the smith's, is perfectly analogous. He says, "He knows Lutton; he was employed by him to manufacture some iron plates; he was employed in September, 1830. It is probable that in 1830, whether you take Mr. Minter to be the inventor, and Lutton the mechanist whom Mr. Minter employed, in either view of the case, Mr. Minter might have given the shape of these plates, and sent Lutton to order them of the smith; and we find that about September, 1830, must have been the period of time at which Mr. Minter would have been engaged in the invention one way or the other. The patent is taken out in the November following. One pair of plates only is ordered in September; that looks like an experiment. Then the patent is taken out in November, and then a dozen pairs are ordered; that looks like carrying into effect the plan when the invention is completed. He does not see any chairs with the plates upon them until two or three months afterwards; and it is quite clear that the patent had been taken out by that time. He says, "He saw some chairs at Dean Street;" that was after the patent was taken out. "He made a dozen plates in November, cannot say the day precisely, it was after the date of the patent. Lutton moved into Dean Street in September; he had employed me before; I think Mr. Minter's name was over the door." Now it was the place where Lutton was working; and therefore, though we have no direct evidence between them one way or the

other, he might not be his servant; he might be assisting him to carry into effect this invention, Mr. Minter wanting an adroit hand to carry into effect the conceptions of his own original head. Then the baker, Charles Wilson, says, and his evidence is most material, "That sometime in 1830, but whether it was in spring or autumn, he cannot tell," and yet that makes all the difference, "Lutton shewed him in the back shop a chair which was very like plaintiff's chair, upon which he was working at the time, it acted by balances, and the action was according to the weight. It was six or eight months before he removed:" now he removed in June or September, 1831; take six months from September, 1831, it will be the beginning of 1831; take away eight months from June, 1831, it will be about November, the period in question. Then he speaks of a young lad; this was probably Chapman, who is not called. Then he says, "There was a person called there called Minter;" the probability is that it was the plaintiff; "he used to come with Lutton on a Sunday into the back shop." At that time, of course, the workmen would be away, and he would be left alone. If Mr. Minter was the person making the invention, and was probably consulting with Lutton for the purpose of getting this conception carried into effect, is it not probable he would come at those times when there was no other workmen about, that the invention might not get out to the trade? Because it not unfrequently happens that some workman turns traitor, gives out the original conception, which is the original invention; some other adroit workman carries on his proceedings in a more rapid way, and so destroys the patent right.

If you are of opinion that the plaintiff is the first and true inventor, that the invention is useful, and that he has given such a description in his specification as would make an experienced workman able to make the chair from it, there seems no doubt that the defendants' chair is an infringement of that patent, because undoubtedly it is

a colourable variation, and a colourable variation only. There is a celebrated case which Mr. Justice Buller mentions, where a party produced a machine which at first sight appeared to be totally different from that which was the subject of the patent; but when you came to consider it, all the difference was, that the head was where the tail should be, and the tail where the head should be; but they operated on the same principle; and so it is precisely here; both the parts are turned. The whole case is now before you. You will consider whether you are satisfied that the plaintiff has made out his case—that he is the inventor of the machine, that the machine is new, that it is useful, and that he has delivered such a specification as would enable a workman to make it, and that that which the defendants have brought out is an imitation of it.

The jury immediately returned a verdict for the plaintiff—thus supporting the validity of the patent.

CRITICAL NOTICES AND REVIEWS.

*Observations upon Naval Architecture or Construction.** By Captain W. Symonds, R. N., Surveyor of the Navy.

An Apology for English Ship Builders, shewing that it is not necessary the Country should look to the Navy for Naval Architects. London, Effingham Wilson, 1833.

The growing importance of naval architecture is acknowledged and felt by every one. We believe that there can be no person who has in the least reflected on the spirit with which this science has been cultivated both by our continental neighbours and by America, but must perceive, that, unless those efforts are met by the exercise of corresponding energy and talent in this country, a

* Published in the United Service Journal, July, 1832.

collision with those powers would assume a very different character to that which has hitherto distinguished our naval tactics. Hence, at such a period, it would be naturally expected, that the naval administration of England would be strenuous in giving every encouragement to the cultivation of this science, and in applying that experience in the theory of ship-building which is derived from a knowledge of the practical application of the mathematical and hydrostatic theorems involved therein. The perusal, however, of the two publications before us teaches us the deplorable fact, that, instead of their pursuing any system founded either on correct theory or on any known principles connected with the laws of floatation, the late first lord of the admiralty (Sir James Graham) declared in his place in the House of Commons, *that the knowledge of practical ship-building was not necessary to a surveyor of the navy.* This opinion* was given during a debate on the appointment of Captain Symonds (author of the first-named publication), to the office of naval surveyor. It was then stated by Sir Byam Martin (formerly comptroller of the navy), "that the very ship which Captain Symonds was employed to build for the government, he was unable to make the necessary calculations for; and that he actually sent to the Navy Board, to ask them to make the calculations, so utterly incapable was he of doing it himself." It may be presumed that this *exposé* of the gentleman's deficiency in the practical knowledge of his new profession called forth the publication first under review, its object being doubtless to shew, that, whatever might be wanting in *practice,* or, as it has been facetiously termed, the "*drudgery,*" of the science, he, at any rate, possessed so refined a knowledge of its *theory* (for it is one of the fashionable errors of the day to assume that *theory* and *practice* mean totally different things), as to more than make up for any want of such secondary qualifications as a knowledge of the

* June 29, 1832. Mirror of Parliament.

practical department of ship-building. It may possibly have been easy for Sir James Graham and his colleagues, to exercise their argumentative powers in shewing the advantage *this* country will derive from the establishment of this new school of *gentlemen ship-builders*, founded as it is on the ruin of the "School of Naval Architecture"—an institution formed under the recommendation of a commission of naval revision, in 1806, which, after mature consideration, advised such an establishment as the only means of advancing a knowledge of the *theory* and *practice*, or the science of naval construction, with the art of ship-building,—this institution, after upwards of twenty years of fostering care, is to be cast adrift. As a question of estimate in the House of Commons, such a course may probably have had its effect, we must do even Mr. Hume the justice of stating, that he deprecated the appointment of one so perfectly unknowing in a most material part of the duties, to fill an office of such high consequence to the country, when there were individuals of great talent and acquirements in this particular branch, who had been purposely instructed, at the expense of the country, and who were, in every way, most capable of fulfilling the duties appertaining to the office of surveyor of the navy; to the country at large, who look at *things as they are*, it becomes a matter of serious import. It is indeed startling to find that those capabilities which are most valued in the lowest department of science, should, in one of the very highest, and in a maritime country the most important, be thrown overboard wholesale. The country knows, if Sir James Graham does not, that the sea will not *reform* its laws, and that it will no more obey the dictum of the first lord of the admiralty and his surveyor, than it would king Canute of old, and unless we deal with it, having a knowledge of its natural laws, and bring *practical experience* to bear on them, we must throw aside all our pretensions to naval superiority, and deservedly sink in the scale of nations.

Extraordinary then, indeed, must be those qualifications, —astounding must be the claims of Captain Symonds as surveyor of the navy, to counterbalance the acknowledged want of every one of those qualities which had hitherto been considered to constitute the *entire merit* of a naval architect. The reader must naturally open his work in expectation of finding the development of some simple and irresistible truth, which had before been overlooked, and that men of experience, and investigation, and genius, had consumed their energies in the promotion of false systems.

That Captain Symonds has put forth opinions having something of the stamp of novelty is quite true, that they are indeed totally different from the hypotheses to which science has led us is also true, but our opinion of the correctness of his views will have been gathered from the tone we have assumed on this occasion.

As the author of the second publication under review has extracted from the work of Captain Symonds those parts which are necessary to elucidate the "*new system*," we propose to take our extracts in the same order which the author of the "Apology," &c. has pursued, preferring as we do, to give his answers and remarks in refutation of Captain Symond's principles to any observation which we might otherwise be induced to make, and we would only add that, in reading this second work, we cannot but be struck with the evident truth, that the complaints of the dearth of talent in the school of naval architecture (of which the author is a distinguished member) are void of foundation. A perfect knowledge of his profession, and a clear and concise mode of stating a forcible truth divested of all quackery and mystery, are evident in the work of this gentleman, who has been called forth to vindicate his profession, and who doubtlessly feels himself, with his brother officers, ill treated by the present government in their attempt to set aside the value of study and experience in the science and practice of ship-building. We cannot but commend the mild tone in which the

work is written, and we feel that it must therefore have the more force; stronger language might not have been palatable, and he might have been visited by the severe displeasure of the most liberal and enlightened administration, who came into power pledged to reform, not to make, abuses. But we consider the author's object has been attained; he has shewn clearly, on the one hand, that the *theory* of Captain Symonds is a palpable fallacy; and, on the other, that the much-traduced "School of Naval Architecture" can produce talent of the highest order.

It will be perhaps desirable in explaining the theory of Captain Symonds, to refer to the annexed diagrams, where figs. 1, and 2, represent midship sections of two

FIG. 1

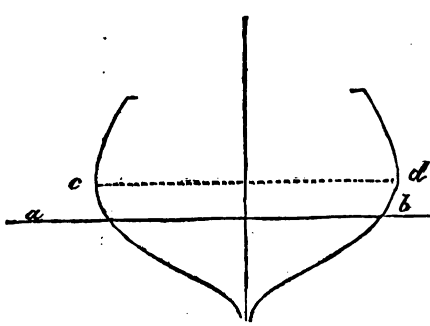
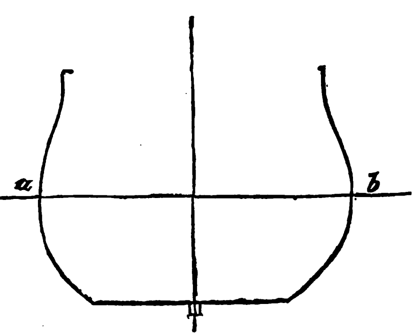


FIG. 2



different formed vessels. Fig. 2, having what is termed a flat floor, and approximating to the general form of ships of war. Fig. 1, is on the principle of Captain Symonds, which expands itself above the water, being constantly broader at *c*, *d*, than at *a*, *b*, the water line. The object of adopting this form will be explained by extracts. The author of the "Apology" thus describes Captain Symonds' principle.

The *distinctness* of the features in Captain Symonds' ships, is discernible enough. That distinctness consists, first, in their having a protrusion or swell, at a distance of from 6 inches to 36 inches above

the water's edge, to constitute what the inventor of the system calls real bearing, or the property of making a vessel "staunch" under canvass. Secondly, an unusual tumbling-home, or *falling-in*, of the topsides, so that the lee guns may be "water-borne," is another distinct feature. This tumbling-home, or narrowing of the topsides, extends quite forward, contracting the bows, aloft, more than ships in general. Thirdly, another distinct feature in Captain Symonds' system, is a remarkably lean after body, causing more flatness in the "buttocks" than has been approved of by former builders.

We now proceed with our extracts, observing that the parts in Italics are from Captain Symonds, and the parts of the Apologist are in our usual small type.

Principle I.

(Captain Symonds's Theory.)

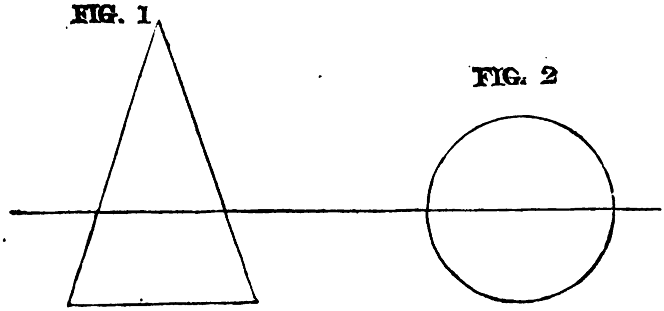
"*Q. Is a flat floor, or any other full feature in a vessel's body, to be termed* bearing, *when sufficient weight has been produced to immerse it?*"

"*A. Nothing under water can be considered bearing, because any additional weight applied after it is immersed, would be the means of* sinking *it; try a full cask, a full tub, or anything having flat or round substruction, provided that there is no expansion or protrusion above the water's edge.*"—*U. S. Journal*, p. 351, line 27.

The sense in which bearing is here introduced, evidently refers to the additional immersion caused by applying additional weight. "Try anything," says Captain Symonds, "having flat or round substruction, provided that there is no *expansion* or *protrusion* above the water's edge." He, therefore, forms his bodies under the impression that if a floating body have no expansion above the water's surface, any additional weight, after the "flat floor" or any other "full feature" is immersed, would *sink* it.

FIG. 1

FIG. 2



Let *fig.* 1, represent the section of a cone floating with its vertex upwards.—

Here we have a "flat floor" immersed; and are we to suppose that any additional weight will *sink* that cone? That is, that it would actually *slip* under water by any additional weight, for no other reason than because its "full feature" is immersed, and that there is no expansion or protrusion above the water's edge? Or if a sphere, *fig.* 2, be of half the specific gravity of water, and therefore only *half* immersed, are we to imagine that because that every part of the lower half "expands or protrudes" from the lowest point to the line of floatation, while every part of the upper hemisphere inclines the *reverse* way, that the former possesses "bearings" which the latter does not? If this be true, what we have hitherto considered to be the LAWS OF HYDROSTATICS are utterly false, the first principles of Hydrostatics being as follows:—

1. That if a body be, bulk for bulk, lighter than water, it will float in water.

2. That the *volume* of water displaced is equal in weight to the weight of the floating body.

Now it is evident, that the volume of water displaced by the upper hemisphere is equal to the volume displaced by the lower hemisphere; consequently, the same weight is necessary to immerse the upper half as the lower, without reference to the position of the "full feature." It must therefore be confessed that the opinions here put forth by Captain Symonds are completely at variance with the received principles of Hydrostatics.

Principle II.

(Captain Symonds's Theory.)

"*Q. What may be termed* 'bearing' *in naval construction?*"

"*A. 'Bearing' is that feature in a vessel's form which protrudes or swells the body to any extent longer or wider than that which the body possesses at the line of floatation, and being* above *the water's edge, sustains her when pressed, by the wind and when embarrassed by shipping a sea.*"—*U. S. Journal*, page 351, line 22.

The best way of answering this query will be, by explaining the usual method of estimating a ship's *stability*, or the power by which she is sustained when pressed by the wind. It is a theorem by Attwood, published in the *Philosophical Transactions of the Royal Society*, 1798; and we should suppose that the nature of the scrutiny to which papers are submitted, before they are recorded as the transactions of that learned body, will induce the reader to pursue Attwood's theorem with care, and compare it with the very different opinions which Captain Symonds entertains on the same subject.

FIG. 1

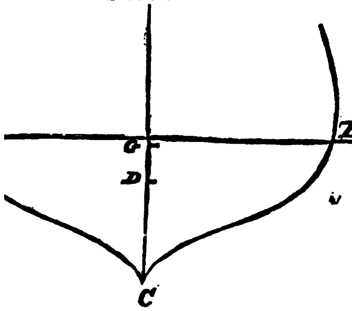
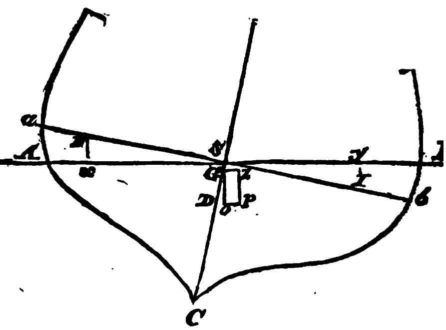


FIG. 2



Let $A\,C\,B$, *fig.* 1, represent the mid-section of a ship when upright, the water's surface coincide with $A\,B$. Suppose G to be the centre of gravity of the ship, and D the centre of gravity of displacement. By the principles of hydrostatics, D and G will be in the same vertical line.

Suppose the ship to be acted upon by some external force, so as to be inclined to a given angle, as in *fig.* 2, the original water-line $a\,b$ intersecting the inclined water-line in same point S. If the weight of the ship remain unaltered, the displacement will be the same in both cases; consequently, the area $A\,S\,a$, which comes out of the water, must be equal to the area $B\,S\,b$, which is forced under water, since the part $A\,S\,b\,C$ is common to the two areas $a\,C\,b$ and $A\,C\,B$.

$A\,S\,a$ is technically called the "emersion," and $B\,S\,b$ the "immersion;" and being *equal*, they are represented by the same notation in the expression which denotes the stability of a ship.

Let E, *fig.* 2, be the centre of gravity of emersion, and I the centre of gravity of immersion. Draw $E\,x$, $I\,y$, perpendicular to $A\,B$; $x\,y$ will be the horizontal distance through which the centre of gravity of the variable part of the displacement has been transferred by the inclining of the ship.

Let $b =$ horizontal distance $x\,y$.
$A =$ immersion (or emersion).
$V =$ displacement (or entire volume of water displaced).
$d =$ distance ($D\,G$) between the centre of gravity of the ship and that of the displacement.
$s =$ sine of the angle of inclination.

To find the centre of gravity of displacement when the ship is inclined, we use the following proportion:—

$$V : A :: b : \frac{b\,A}{V}$$

Then is $\frac{b\,A}{V}$ the value of the horizontal distance through which the centre of gravity of displacement has been transferred. Hence, draw $D\,p$ horizontally and make it equal to $\frac{b\,A}{V}$; p will be the point through which the whole effect of the buoyancy (equal to the entire weight of the vessel) will act in a vertical line, to restore the ship to an upright position. Draw $G\ z$ horizontally, meeting the vertical line, $p\ z$; and draw $G\ o$ perpendicular to $D\,p$. $G\ z$ is called the "*measure*" of the ship's stability, because it is the distance at which the mean effect of the displacement acts to restore the ship to an upright position, by turning round an imaginary axis passing through the centre of gravity G.

Consequently, $G\,z \times V =$ moment of stability.

Now, $D\,o =$ sine of inclination to radius $D\,G\,(= d)$.

Therefore, $D\,o = d\,s$.

$$\text{Consequently, } G\,z = D\,p - D\,o = \frac{b\,A}{V} - d\,s;$$

and $G\,z \times V = b\,A - d\,s\,V$* which is the correct expression for the moment of stability.

If d, s, and V, be constant quantities, the moment of stability will vary as $b\,A$.

Now, A is the quantity immersed or emerged at a given inclination, and b is the horizontal distance through which the centre of gravity of immersion is transferred: hence we perceive that the form and magnitude of that part of the body of the vessel which comes *out* of the water affects the stability of a ship as well as that part which is immersed.

* If the vessel's inclination be indefinitely small, the angle $A\ S\ a$ will become evanescent; that is, the area $A\ S\ a$ may be considered as a triangle, and the angle $a\ A\ S$ a right angle. Now, $S\ x$, which is equal to $\frac{2}{3}\ S\ A$, varies as $S\ A$; hence, $x\ y$ varies as twice $S\ A$, or as the *breadth* of the ship. And the area $A\ S\ a$, which varies as $S\ A^2$, varies as $\overline{breadth}|^2$. Consequently, $b\ A$ (in the expression for stability) varies as $\overline{breadth}|^3$: and, taking the length of the vessel into consideration, the stability will vary as *length* $\times$ $\overline{breadth}|^3$. The negative part of the expression, viz., $d\ s\ V$, vanishes, since s becomes evanescent. Therefore, in comparing the stabilities of ships at evanescent angles, we say that they vary as the *fourth* power of their breadth, provided the proportion of length to breadth be the same in all cases.

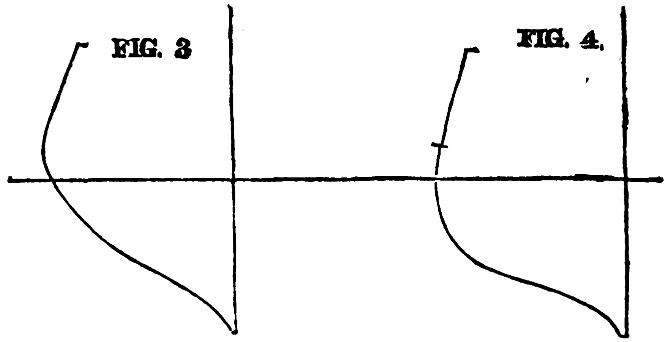


FIG. 3 FIG. 4.

Figures 3 and 4 are midship sections having the same extreme breadth, and equal areas below water. Fig. 3 has a distinct feature of protrusion; *fig.* 4 does not get rid of the extreme breadth so suddenly as *fig.* 3, but preserves a more general fulness in the vicinity of the water-line.

The difference of form between *figs.* 3 and 4, may be clearly seen by inspecting *fig.* 5; in which the black line represents *fig.* 3, and the ticked line *fig.* 4.

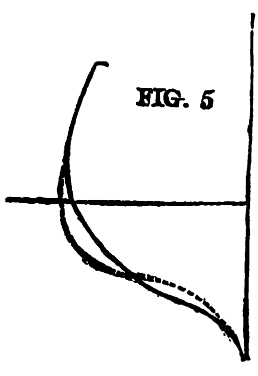


FIG. 5

According to the general expression in the theorem, the stability of *fig.* 4 will be greater than the stability of *fig.* 3, at a given angle of inclination (if d remain the same), because both b and A will be greater in the former than in the latter case.

If Attwood's theory be correct, Captain Symonds' principle of "*protrusion*" must therefore be a fallacy.

Principle III.

(Captain Symonds's Theory.)

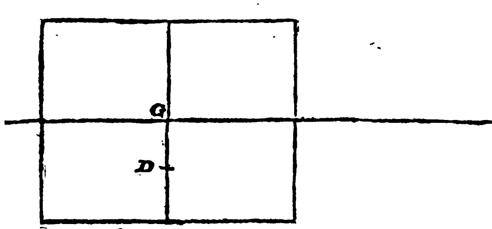
"*Q. Which form will float most erect and steadily without being*

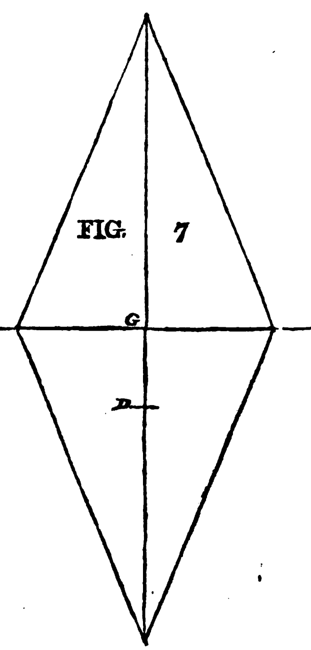
in danger of oversetting when the cargo is removed, and with only a small degree of ballast?"

"*A. The broad sharp form; because that with a flat floor would have no hold of the water, and might easily fall on its side.*" (*P.* 352, *line* 38, *U. S. J.*)

The principle of this question may be thus exemplified. A body specifically lighter than water has a tendency to *rise*, in the same manner that a body in air, specifically heavier than the atmosphere, has a tendency to *descend*. It might just as well be said, therefore, that the stability of a body on shore (a column for instance) is increased from being high, because it has a "hold" of the *air*, as assert that the stability of a floating body (every particle of the immersed part of which has a tendency to rise) is increased from being deep, because it has a "hold" of the water. The two cases are analogous, differing only in *degree*.

FIG. 6





If a cylinder and double cone of equal contents (*fig.* 6 and 7) be each half immersed (their sectional areas at the water's surface being equal), the cone will, from the properties of the figure, be *three times* as deep as the cylinder; but at a given angle of inclination, the stability of the cylinder will be greater than the stability of the cone,

because the *positive* part of the expression in the general theorem will be greater in the case of the cylinder, while the *negative* part of the expression will be greater for the cone (since the centre of gravity of the body remains unaltered, while the centre of gravity of displacement is lowered); that is, in the expression $b\ A - d\ s\ V$, both b and A are greater in the case of the cylinder, but d is greater in the case of the cone. And yet the cone has three times as much "hold" of the water as the cylinder.

If an EXPERIMENT would be more satisfactory, take an empty cask, and fasten a piece of plank, like a keel, edgewise along the lower part of the builge, the plank being specifically lighter than water; the effect of that increased depth would be to *turn* the cask, instead of "holding" it in its original position. In other words, it would destroy the stability. Again; a piece of plank (say ten inches wide and two inches thick) would float flatwise with considerable power of stability, but if that plank were to be gradually increased in thickness until its depth actually exceeded its breadth, it would suddenly turn upon its side, thereby showing that depth does not impart the property of holding the water.

Principle IV.

(Captain Symonds's Theory.)

"*Q. Where ought the feature of bearing or swell on a vessel's exterior to exist, which constitutes real bearing?*"

"*A. It is presumed from* 6 *inches to* 3 *feet (according to the size of the vessel) above the line of floatation, in a man-of-war when fitted for six months, in a merchant vessel when deeply laden.*"—*United Service Journal*, page 351, line 33.

The fact is, we have no such term as "*bearing*" in the science of naval construction; but so long as we understand each other, there is no occasion to dispute about words.

We have already shown that the form *below* water within the limits of inclination, has just as much to do with sustaining the ship when pressed by the wind, as the form *above* water. If Captain Symonds can show that we are in error, of course he will do so, because in proving us to be wrong, he will prove himself to be right. The idea of first *presuming* where the protrusion should be, and then saying, upon presumptive grounds, that the bearing, or swell, should be within the latitude of from 6 inches to 3 feet, is altogether so unmathematical, that we are by no means inclined to place any confidence in the unsupported assertion of a journalist* who has recently affirmed that

* Metropolitan Magazine, No. XV. *Naval Architecture.*

Captain Symonds is a "thorough mathematician, and a good algebraist."

The question which aims at a definition between bearing and *real* bearing, appears to be a distinction without a difference. If any feature of a vessel really be a feature of bearing, how can it be otherwise than a feature of "real" bearing? Surely, Captain Symonds cannot mean to say that there are real bearings and imaginary bearings!

It would impose a tedious task on the reader, to take him through the whole series of Queries and Answers contained in Captain Symonds' pamphlet on Naval Construction; moreover, it is quite unnecessary to do so, since the laws of Hydrostatics and the theory of the stability of floating bodies, are the fundamental principles in naval architecture; and it must be obvious that if Captain Symonds be wrong in first principles, he cannot be right in practices which are founded upon those principles.

We presume that not another word need be said to demonstrate the utter fallacy of the "*New System:*" we shall scarcely stop to inquire into the claim of novelty. That which is not intrinsically excellent in itself, can derive no value from mere novelty. A fallacy in science may sometimes secure to its projector the credit of ingenuity, but it is in cases only where there is combined with its absurdities some indistinct perception of truth. In the present instance, then, the claim of novelty can avail nothing to rescue Captain Symonds and his system from the overwhelming overthrow they have met with at the hands of the Apologist.

Much has been said for Captain Symonds because his experimental frigate, the Vernon, did, in the contest with the Donegal, Castor, and other vessels, outsail them. The Apologist, however, proves that large ships possess many advantages over small ones, "the area of the sails, or plane of *propulsion,* increasing in a greater ratio than the midship section of the vessel or plane of *resistance.*" Hence the propelling power increases in a greater ratio than "the resistance, which gives an advantage, in point of sailing, to the larger vessel. The

large vessel has also an advantage "arising from the momentum being less easily overcome, or its progressive motion less effective by the shock of a wave and the general agitation of the sea."

We have been induced to extend our extracts much beyond the limits intended, but the paramount importance of the subject has prevented us from omitting any thing bearing on the inquiry before us. The mere merit of Captain Symonds is of itself a question of minor import compared with the principles of his appointment, which has already caused the country an immense outlay in the construction of vessels which are notoriously inefficient.* The Vernon, though built under the superintendance of one of our first practical builders, and of the very best materials and workmanship, proved in her working qualities to be weak, uneasy, and not at all equal in speed to vessels of the same size of the ordinary construction. Her defective condition on her arrival at Plymouth, is well known. She has since been removed to the West India station, and is for the present beyond our criticism. We cannot but remark, that it is surprising that this vessel, on which Sir James Graham† begged the House of Commons to form their judgment of the naval surveyor's merits, and on the success or failure of which he was quite willing that the propriety of his appointment should rest, should scarcely have been afloat before she was placed beyond the sphere of observation. We will conclude our remarks with a few extracts respecting the "School of Naval Architecture," taken from the Apologist, who is so able an advocate for this admirable establishment. We shall commence with his answer to Sir James Graham's arguments for not appointing a practical man to the office of surveyor of the navy.

Another point to which we would briefly advert is, that Sir James

* We see by the Times, 26th July, that his twelfth ship has just been launched.

† Mirror of Parliament, June 29, 1832.

Graham should consider that a practical ship-builder is ineligible to the office of Surveyor of the Navy, merely because he has been a shipwright.* Admirals who have risen from before the mast, and General Officers who have been elevated from the ranks, are not, we believe, remarkable in history for having evinced that degree of fellow-feeling towards their subordinates, which has prevented a due enforcement of discipline: and it is admitted, by proverbs out of number, that an overseer who can tell from personal experience where irregularities are most likely to be met with, is the most fit person to detect abuses. If, however, the fear of too much fellow-feeling still be a difficulty in the opinion of the First Lord of the Amiralty, that objection does not apply to the School of Naval Architecture; for the early professional pursuits of its members no more resemble the habits of the operative mechanic, who earns his livelihood by handicraft, than the pursuits of young gentleman who enter the navy under the expectation of rising progressively to the top of their profession, resemble the habits of a ship's company. But this is not the strongest light in which we view with sorrow the appointment of an unprofessional gentleman to the surveyorship. The greatest hardship, in our opinion, is the innovation on professional usage; unless, indeed, it were the commencement of a new system of providing an improved succession of naval architects.

In trades, and in the "liberal" professions also, it is necessary to go through certain forms to constitute eligibility to preferment. In the ship-building department, for instance, a man would not be employed among other shipwrights even on daily labour, unless he could produce legal indentures to prove that he had regularly served his time to the trade. It is the same at the Universities, and it is so in the Navy: persons must keep their *term* to become eligible to promotion. And yet, the present surveyor has not only overcome the first difficulties, but actually steps over every other grade to fill at once the highest post of honour in a department not even his own! What would be the feeling throughout the navy, if the First Lord of the Admiralty were to tell the House of Commons that the Right Hon. Lord Yarborough, Commodore of the Royal Yacht Club, had been represented to him as an individual of eminent attainments in naval

* *Sir James Graham's Speech.* But I must state my objection to place a shipwright in the situation of Surveyor of the Navy; that objection is, that a person who has himself been a shipwright, would necessarily have too close a connexion with the other shipwrights of the yard, to enable him to exercise that control over them which the public interests may make it requisite should be exercised; and wherever this salutary authority is relaxed, abuses and irregularities are always sure to be the consequence.

evolutions; that he is not only a great tactitian, but possesses a superior conception of the discipline of a ship's company; that having carried pieces of ordnance in his yacht, he was conversant both in the theory and the exercise of naval gunnery; and that, upon the whole, he thought him more competent than any other gentleman he could possibly select to hoist his flag on board a man-of-war, and take command of a British fleet? What, we ask, would be the feeling throughout that honourable profession which is at once the pride and boast of England, and of which *Captain Symonds* is so bright an ornament, if such a sentiment were uttered?

It is deemed unnecessary to enter more fully into this part of the subject; trusting that enough has been said to shew, that if it were considered desirable to select a surveyor of the navy who should be a practical shipwright, capable of directing the mechanical department of the dock-yards, also of judging of the application and economy of labour, and the discipline of the dock-yards, and the adjustment of the whole scheme of labour, Captain Symonds cannot be so competent as many other gentlemen to fill the office of surveyor. The question now is, whether there is any evidence on record to prove that a surveyor of the navy is required to be a practical shipwright.

It seems almost needless to remark, that a School of Naval Architecture was not established in this country before it was much wanted, since it has freely been admitted that "every victory which reflects honour on our sailors conveys a stigma on English shipbuilders." Every writer on naval science tells the same story; and all agree, not only that we cannot pride ourselves on genuine British models, but that models of foreign origin which have been held up as objects worthy of imitation, have often been ruined by unscientific attempts at alterations. French ships in particular have been singled out as possessing remarkably good qualities, and their superiority is invariably accounted for by the fact that the French are a scientific people, and that they apply their science to naval architecture. England, on the contrary, has not cultivated science, in connexion with ship-building.

Confident of victory, by former success—practised in seamanship—possessed of a numerous fleet, morally and physically superior to our enemy's—and expert as shipwrights, it has been our failing to believe that superiority in strength and the good cause of defending the sovereignty of the seas, were everything. But the Commissioners of Naval Revision, after a most laborious attention to the subject, pointed out the true situation in which the country stood, in 1806, and recommended a School of Naval Architecture as the only means of supplying a succession of naval architects, qualified, in a scientific sense, to meet the exigencies of the nation. The members of the

Board of Revision could not have been actuated by any sinister motive: the expectation of individual patronage was completely out of the question. They formed their opinions deliberately, upon the results of a minute inquiry into the subject, and identified their names with their labours. They examined most respectable witnesses, and suggested what appeared to them, upon mature investigation, the only plan for uniting *theory* with *practice;* that is, the Science of naval construction with the Art of ship-building. But although the School of Naval Architecture has been instituted nearly twenty-two years, the department in which naval construction has always been attended to, has not undergone the proposed modification. Had some of the members of that institution applied their theoretical knowledge to available data, we must, ere this, have arrived at a very improved system of naval architecture: but without a department in which the principles of naval construction can be sedulously prosecuted, English ship-building must continue to be carried on with the same uncertainty and probability of failure by which it has hitherto been characterized.

It is in some measure satisfactory to the members of the School of Naval Architecture, to find that many individuals who have evinced an interest in the advancement of naval science, and who have had the means of judging of the necessary qualifications for a naval architect, have referred to that establishment as a source from which the nation may hereafter look for much benefit in the science of construction; but it has unhappily happened, that those liberal professions have rarely emanated from a quarter where the fostering protection of an influential patron could then assist in so desirable an object. The members of the School of Naval Architecture were admitted into the establishment by public examinations, which were conducted with strict impartiality. The candidates were always numerous, but the number of students admitted was invariably limited; and perhaps this is the only national institution in which merit without patronage could avail. This feature ought to be its strongest recommendation, but it has proved to be the reverse. The School of Naval Architecture has never had the good fortune to have a patron to bring it into notice; and having wanted that, it seems that it has wanted everything.

Among the numbers of writers who have declared their confidence in the advantages to be derived from the School of Naval Architecture, we must not omit to name *Captain Symonds,* who has prefaced his observations on naval construction in terms of which the following are a part. "It is devoutly to be hoped that the college, at present in its infancy, will, in future, promote the *neglected* science of naval architecture, and that the encouragement of premiums to students and

others, producing the best and most approved models, will be offered by Government. Experiments in naval construction, on a large scale, would be found too expensive and ruinous, until the *science* in all its branches is better understood."

When Captain Symonds indited this passage, he, like many in the present day, might not have been aware that the members of the School of Naval Architecture take no part in the neglected science of naval construction, so long as they hold subordinate situations; nor is it likely he could have anticipated that an "infant" institution (a term no longer applicable) would be so completely lost sight of, that twenty-two years would elapse without any one of its members having at any time given even an opinion, in an official way, on the subject. Can the present Admiralty be aware of this? Can the public conceive it possible? Is it likely that the members of the House of Commons who hear the charge of professional incompetency imputed to the whole of the ship-building department, would suspect that not one of them has even prepared an original design (of his own) from which a ship was built; or been called upon candidly to show wherein the deficiency of the present system consists? We can assure the reader that the School of Naval Architecture has neither been heard, nor tried. Heard, perhaps, they have been; but whether they have been listened to, is another question. They have spoken through the press, by publishing a great deal of scientific matter in various forms, and by carrying on a series of "Papers on Naval Architecture, and other Subjects connected with Naval Science," for seven years.* The journal which they have conducted is known to have taken a very creditable stand among the scientific periodicals of the day; and they have thus made some return for the education they have received, and given some proof that public money has only been "unprofitably laid out" upon them, because they have never been permitted to assist in putting the English method of construction upon a scientific footing.

Persons unconnected with the service infer, especially at the present period, that failure of some kind has actually attended the plan on which the School of Naval Architecture was founded; they cannot comprehend what the institution can possibly effect, because they do not hear, after a reasonable lapse of time, what it has done. They

* *Whittaker*, half-yearly, 5s. 6d. This work, which was edited by Messrs. Morgan and Creuze, has been recently discontinued, without any alleged reason on the part of the conductors. It is supposed, however, that they saw the impossibility of carrying on such a publication without appearing to write in opposition to the new system of naval construction, which is irreconcilable with the principles on which the Papers on Naval Architecture were conducted.

conclude either that its members have failed to exert themselves, thereby forfeiting their original expectations; or, that if they have exerted themselves to advance naval science, it has been without success.

The grounds on which we set out forbid everything in the shape of conjecture, otherwise it might not be difficult to assume causes (we will not say reasons) why none of the new school have yet been called into action in the capacity of naval constructors; that is, attached to an office in which the principles of naval science might, for the first time, be cultivated. An exclusive principle has hitherto shut the door against the introduction of science into the naval architectural department; and it is to be feared that even the individuals now in power (the naval administration) have been biassed by opinions which would not bear scrutiny.

The Conchologist's Companion. By MARY ROBERTS. London: Whittaker and Co., 1834.

THIS is a highly interesting little volume, consisting of twelve letters, constituting a familiar introductory treatise to the study of conchology. We cannot but be pleased with the feeling in which this work is written, carrying the mind up from the object under description to that Providence who is at once the cause and protector of all. The authoress is evidently an ardent lover of nature, sparing neither time nor labour in cultivating her mind with nature's truths; and with a spirit and elegance not often met with, conveys to her readers a correct and most pleasing, at the same time most familiar, view of the manner in which an all-bountiful Providence, with watchful care, renders to all their due proportions, giving to the most minute shell and its inhabitant, appropriate mechanism to meet the various circumstances of its nature, and to ward off the perils to which such fragile forms are subject. Many writers, and even intelligent ones, have raised objections to the study of natural philosophy, stating that it fosters in its cultivators an undue and overweening self-conceit; to such writers we would re-

commend even this little work as a sufficient refutation to their reasoning. The study of nature, more than any other, tends to expand man's mind into a knowledge of himself, and we may add, in the language of Herschel, such pursuits open to man "on all hands, the knowledge of the trivial place he occupies in the scale of creation, and the sense continually pressed upon him of his own weakness and incapacity to suspend or modify the slightest movement of the vast machinery he sees around him, must effectually convince him that humility of pretension, no less than confidence of hope, is what best becomes his character."

We shall finish our notice of the Conchologist's Companion, by giving a few extracts. After a description of the construction of the Lepas, which our readers are aware is the generic name of the Barnacles which adhere to ship's bottoms, the writer goes on to say,

These extraordinary shell-fish are never found detached from other substances. They adhere by the base or stalk, not only to rocks and stones, but even to marine animals, such as the whale and turtle. They are also found on vessels, and increase so rapidly in size and number, as sometimes to impede their progress in sailing. And yet, though generally fixed to other bodies by the base, in some few instances, as those of the *L. Scalpellum; L. Anserifera; L. Anatifera;* or Knife-like, Striated, and Duck Barnacles, with several varieties emanating from them, they are attached by a stem. These appendages differ considerably both in character and substance; they occasionally resemble a smooth film-like tube, of a fine texture, tinged with bright red or orange; whilst others are of a coarser texture, darkly coloured, and covered with little warts.

The peculiar structure of these elegant varieties has justly caused them to be compared to the crocus, when peeping from the mossy rocks to which they are frequently attached.

The mention of the Lepas is further connected with an extraordinary fact, that occurred some years since, at Sidmouth. A small coasting vessel with a few hands on board, sprung a leak, and went down within sight of several persons on the Esplanade. It was a melancholy circumstance, and as such excited much commiseration; but time passed on, and the occurrence was forgotten, till one morning the vessel gradually arose from out the water, and was driven by

the tide upon the shore. The beach was soon covered with spectators, and on inspection, the sides, the deck, the remains of the mast, in short every part, was seen bristling with Barnacles. The meal-tub, especially, was so covered with them as to present a beautiful and novel appearance. The reason of the vessel's reappearing was now obvious; the long tubes of the Barnacles, being full of air, had rendered the sunken vessel specifically lighter than the water, and she arose from off her watery bed, after the lapse of nearly twenty years. The person from whom I heard this curions incident was one of the spectators: he had preserved some remarkably fine specimens. It is a fact that may possibly suggest some mode of rendering vessels so buoyant, as not to sink in even the most tremendous storms.

The description of the species called the Pinna is interestingly written:

In another species, the Pinna, Finshell,* or Seawing, a beautiful and well known genus, we shall shortly have occasion to observe a most extraordinary compensation, not resulting from any peculiarity in the structure of the animal itself, but supplied by the deficiencies of another. At least twenty different species are included under this division; and here it is not unworthy of remark, that however different individuals may vary in size and colour, the usual form of their testaceous coatings uniformly resembles that of the larger species of Muscles, being long and tapering towards the opposite extremity. They are, also, generally brittle and horn-like, and are occasionally enriched with a steel-like blue, or copper colour. Some peculiarity in the animal inhabitant uniformly furnishes a clue to its mode of life. The construction of the Pinna points out its adaptation to smooth waters and sheltered bays; and though generally found in the Mediterranean, Indian, American, Atlantic, and European oceans, as well as in the Adriatic and Red seas, they are seldom seen on bold and rocky coasts, exposed to the furious surgings of the tide. The classic shores of the Mediterranean are, consequently, one of their favourite resorts; and hence the rocks under Cape St. Vido, once celebrated for an abbey of Basilican monks, as well as the shores of the Mare Grand, are completely studded with the interesting shell-fish.

> Thousands of spinning worms,
> That in their green shops weave the smooth-hair'd silk,
> To deck her sons. *Milton.*

They are elegantly termed the silk-worms of the ocean, in allusion

* Pinnu, or Piuné, is the Greek name for this fish: it was eaten by the ancients, and occasionally called the Naker, Naire, or Nacker; a word, the meaning of which seems unknown.

to the fine silky beard, or byssus, by means of which they moor themselves firmly to the rocks, or allure small fish by the floating or trembling of the filaments in the water.

This they possess in common with the Muscle. But instead of an hundred undivided, parallel, and flattened fibres, terminated with a circular gland, furnished with absorbents, and growing from the body of the animal, we have here a machine as incontestably mechanical as that of a wire-drawer's mill. The Pinna is provided with an extensile member, like a finger, and this contains a glue, which the animal protrudes at pleasure, through a variety of minute perforations in the tip. This glue, or gum, as in the instance of the common spider, or the silk-worm, having passed through these apertures, becomes threads of almost imperceptible fineness; and these threads, when joined, compose the silk which is so much valued by the Sicilians. But the animal first attaches the extremity of the thread, by means of its adhesive quality, to some crag, or pebble, of unusual size; and when this is effected, the Pinna receding from that point, draws out the thread through the perforation of the extensile member by a process, which Paley, in describing the similar operations of the terrestrial silk-worm, justly compares to the drawing of wire. One difference only subsists. The wire is the metal unaltered, except in figure: whereas, in the forming of the thread, the nature of the substance is somewhat changed, as well as the form; for, as it exists within the insect, it is merely a soft and clammy glue; the thread acquiring, most probably, its firmness and tenacity from the action of the air upon its surface at the moment of exposure. This property is, consequently, a part of the contrivance.

The mechanism itself consists of the extensile member, which the animal propels at pleasure; of the reservoir in which the glue is collected, and of the external holes communicating with it,—while the action of the machine is seen, in forming the thread, analogous to that of making wire, by forcing the prepared material through holes of proper dimensions. The secretion is an act too subtile for our discernment, except as we perceive it by the produce. But one thing answers to another: the secretory glands to the quantity and consistence required in the secreted substance, and the reservoir to its reception; while the outlets and orifices are constructed, not merely for relieving the reservoir, but for manufacturing its contents into a form and texture of great external use to the life and functions of the insect. But the texture is not only essential to the welfare of the inhabiting Mollusca, it also constitutes an important article of commerce among the Sicilians; for which purpose considerable numbers of Pinna are annually fished up in the Mediterranean, from the depth of twenty or thirty feet. An instrument, called a cramp, is used for the

purpose: it is a kind of iron fork, with perpendicular prongs, eight feet in length, each of them about six inches apart, the length of the handle being in proportion to the depth of the water; for, notwithstanding the extreme delicacy of the individual threads, they form such a compact tuft, that considerable strength is necessary in separating the shells from the rocks to which they adhere.

This tuft of silk, termed by the Sicilians *lanapenna*, is then broken off, and sold, in its rude state, for about fifteen carlini a pound, to the countrywomen, who wash it thoroughly in soap and water. They then dry it in the shade, straighten the threads with a large comb, cut off the useless root by which it adhered to the animal, and card the remainder; by these means a pound of coarse filaments is reduced to about three ounces of fine thread. This is fabricated into various articles of wearing apparel, such as stockings, caps, gloves, and waistcoats. The web is of a beautiful yellow brown, resembling the burnished golden hue which adorns the backs of some splendid flies and beetles; an effect produced by steeping it in lemon-juice, and afterwards pressing it with a warm iron.

A considerable manufactory of stuffs and various articles of wearing apparel is established at Palermo; they are extremely elegant, and vie in appearance with such as are fabricated from the finest silk.

In the year 1754, a pair of stockings was presented to Pope Benedict XV., which, in consequence of their extreme fineness, were enclosed in a small box about the size of one for holding snuff. A robe of the same singular materials is mentioned by Procopius, as the gift of a Roman emperor to the satrap of Armenia.

LIST OF NEW PATENTS.

RICHARD WALKER, of Birmingham, in the County of Warwick, Manufacturer, for an improvement in wadding for fire arms.—Sealed June 26, 1834.—(*Two months.*)

JONAS BATEMAN, of Islington, in the County of Middlesex, Cooper, for an apparatus or instrument for saving human life or other purposes in cases of shipwreck or other disasters by water.—Sealed June 30, 1834.—(*Six months.*)

JOHN BARTON, of Providence Row, Finsbury, in the County of Middlesex, Engineer, and SAMUEL and JOSEPH NYE, both of St. Andrew's Row, Southwark, in the

County of Surrey, Mechanics, for improvements in the construction and application of pumps and machinery for raising fluids and other purposes.—Sealed July 1, 1834. —(*Six months.*)

THOMAS MARTIN CLERK, of Withby Bush, in the Parish of Rudbaxton, in the County of Pembroke, for certain improvements in engines or machinery for cutting or preparing slates or other similar substances or materials for various useful purposes.—Sealed July 3, 1834. —(*Two months.*)

JAMES HARDY, of Wednesbury, in the County of Stafford, Gentleman, for a certain improvement or certain improvements in the making or manufacturing of axle-trees for carriages.—Sealed July 3, 1834.—(*Six months.*)

BENJAMIN HICK, of Bolton-le-Moors, in the County Palatine of Lancaster, Engineer, EDWARD EVANS, the elder, of Oldham, in the said County, Coal Proprietor, and JOHN HIGGINS, of Oldham aforesaid, Engineer, for certain improvements in the construction and adaptation of metallic packings for the pistons of steam and other engines, pumps, and other purposes, to which the same may be applicable.—Sealed July 4, 1834.—(*Six months.*)

WILLIAM HIGGINS, of Salford, in the County of Lancaster, Machine Maker, for certain improvements in machinery used for making twisted rovings and yarn of cotton, flax, silk, wool, and other fibrous substances.—Sealed July 7, 1834.—(*Six months.*)

JOHN GOLD, of Birmingham, in the County of Warwick, Glass Cutter, for certain improvements in cutting, grinding, smoothing, polishing, or otherwise preparing glass decanters, and certain other articles.—Sealed July 7, 1834.—(*Six months.*)

JOHN ASTON, of Birmingham, in the County of Warwick, Button Maker, for an improvement in the manufacture or construction of buttons.—Sealed July 10, 1834.—(*Six months.*)

George Beadon, of Taunton, in the County of Somerset, Lieutenant in the Royal Navy, for a machine or apparatus for preventing boats or other floating bodies from capsizing or overturning when oppressed by too much sail, and for easing off the ropes and sheets of different classes and descriptions of vessels, parts of which machine or apparatus may be applied for other purpose. —Sealed July 10, 1834.—(*Six months.*)

Lemuel Wellman Wright, of Sloane Terrace, Chelsea, in the County of Middlesex, Engineer, for certain improvements in machinery for cutting tobacco, and which machinery may be applicable to other useful purposes.—Sealed July 10, 1834.—(*Six months.*)

John Ramsbottom, of Todmorden, in the County of Lancaster, Mechanic, and Richard Holt, of the same place, Ironfounder, for certain improvements in the construction of power looms, for weaving cotton and other fibrous materials into cloth or other fabrics.—Sealed July 12, 1834.—(*Six months.*)

Peter Wright, of the City of Edinburgh, Manufacturer, for an improved method of spinning, twisting and twining cotton, flax, silk, wool, or any other suitable substances.—Sealed July 17, 1834.—(*Six months.*)

William Septimus Losh, of Walker, in the County of Northumberland, Gentleman, for an improved method of bleaching of certain animal fats, and certain animal, vegetable, and fish oils.—Sealed July 17, 1834.—(*Six months.*)

James Warne, of Union Street, in the Borough of Southwark, pewterer and beer engine manufacturer, for certain improvements in engines or machinery for raising, drawing, or forcing beer, ale, and other liquids or fluids. —Sealed July 17, 1834.—(*Six months.*)

THE

REPERTORY

OF

PATENT INVENTIONS.

No. IX. NEW SERIES.—SEPTEMBER, 1834.

Specification of the Patent granted to ROBERT WILLIAM BRANDLING, *of Low Gosforth, in the County of Northumberland, Esquire, for Improvements in applying Steam and other Power to Ships, Boats, and other purposes.*—Sealed November 19, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Robert William Brandling, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

By this mode stationary and locomotive engines may be employed in dragging ships and vessels along rivers and canals, and for other purposes. These objects are accomplished by means of resisting-guides, or frames, moving upon, and retained in a proper position, by wheels and

rollers fixed to strong posts, at certain intervals, along the sides of the river or canal, and allowing these guides or frames, with the arms by which they are attached to the ropes or chains from the stationary engines, or to the locomotive engines, to pass without any obstruction. These guides or frames may be of any length, but should be at least sufficiently long to insure the point of traction where the towing-line is fixed, being always between two of the points of resistance, or the points of contact where the guides or frames press against the resisting-rollers, These guides, when stationary engines are used, are moved by single or double ropes or chains, attached to the ends or arms, or by endless ropes or chains, attached to one or more of the arms projecting from the guide or frame, and which endless ropes or chains are detached from and attached to the guides and frames by machinery, or by the attendants, at those points where one stationary engine is intended to cease acting and another to commence. Any number of locomotives may be attached to these guides or frames at different points, according to the power required; and, in addition to these retaining guides and frames, with their wheels and rollers, these locomotive engines may be kept in their proper position, and the power of the engine in dragging the vessel, regulated or increased by means of compression-wheels, or rollers, forced against a rail by strong springs, or weights and levers. These wheels act horizontally, or in any other direction in opposition to the line of traction. The rails against which these wheels act, do not necessarily bear any part of the weight of the engine, the wheels carrying which move on the towing path. Sufficient play is allowed by the arms and connecting rods, springs, and wheels, so that no sudden jolt, elevation, or depression of the engine, can materially disturb the guides or frames and compression-wheels, so as to prevent their producing the desired effect. These compression-wheels are worked by cogs and lanterns, which

allow them to yield freely, and in the proper direction to the compressing-power. The seats supporting the axles of these wheels move in grooves, and are acted upon by the springs or levers. These compression-wheels, and the mode of applying and moving them, with the resisting-rail, are parts of this invention. The general principles, and their application by which the proposed objects are effected, are shewn distinctly in the accompanying plans, numbered 1, 2, and 3. The mechanical construction, and the size and proportion of the different parts, must depend upon the strength of the materials, and other circumstances, and can only be accurately adjusted by actual experiments, which could not be safely made till after the period had expired which is allowed for enrolling the specification.* If the towing-path or road is straight and level, the guide or frame may be stiff and without joints, otherwise they must be jointed, the gradual and proper adaptation of the different parts to the curve being effected by strong levers, and tooth and pinion wheels, or by the use of the resisting-rail and compression-wheels, in which case the front wheels of the locomotive engine must be allowed to move to answer the bend, and the resisting-rail at each end of the curve must have a portion of it straight at least equal in length to the distance between the joints of the guide or frame. The rollers also, in this case, which support and retain them, must be of such a length as to allow those parts of the guide or frame which rest upon or are retained by them to move freely while forced by the compression-wheels and resisting-rail to assume the proper curvature.

This invention may be used in dragging vessels through narrow tunnels, stationary engines being fixed at either or both ends, and the wheels and rollers at the sides or

* This is an error which many fall into. An invention is secure from the moment of sealing the patent; the time allowed for enrolling the specification is intended to mature the invention in perfect security under the patent, the validity of which is in no way injured by the patentee's making, using, and selling the invention in the most public manner.—*Ed.*

top: and it may be employed also in moving passage-boats across rivers, or buoys in harbours, and other places where it is desirable to retain the ropes or chains at the bottom, so as not to interrupt the navigation, but in such cases a diving-bell ought to be provided to meet any accident that may happen, notwithstanding the necessary precautions of double ropes or chains, and safety-lines attached to the guides or frames, without bearing any part of the ordinary strain.

This invention may be applied to dragging any carriages upon common roads or rail-roads, and up any ascent, and whether moving along or crossing them, or passing throughpleasure grounds or along quays, where the ropes, or chains, or guides, would be a nuisance and obstruction, the guide or frame-posts, rollers, and ropes, may all be below the surface, nothing appearing but the top of the arms moving along a narrow groove. The guides are so called, in this invention, when composed of one or more pieces joined longitudinally; and frames, or resisting-frames, when of two or more pieces and joined laterally by other pieces.

Description of the Drawing.

Plan No. 1, fig. 1, A, A, A, river or canal. B, B, vessel. C, C, C, strong posts in the towing path. D, D, D, D, resisting-guides or frames. E, E, E, wheels or rollers. G, G, part of the arms attaching the guides or frames to the locomotive engines, or the ropes or chains of stationary engines. H, H, axle of the locomotive engine. I, I, I, wheels of the locomotive engine. K, towing-line. L, L, towing-path. Figs. 2, 3, and 4, shew some of the modes of attaching the guides or frames to the locomotive engines, and keeping them in their proper position.

Plan No. 2, sections of posts, rollers, guides or frames, and attaching-arms, on a larger scale. The dotted line, fig. 5, shews one of the forms of the attaching-arm, to which the rope is supposed to be fixed, but different

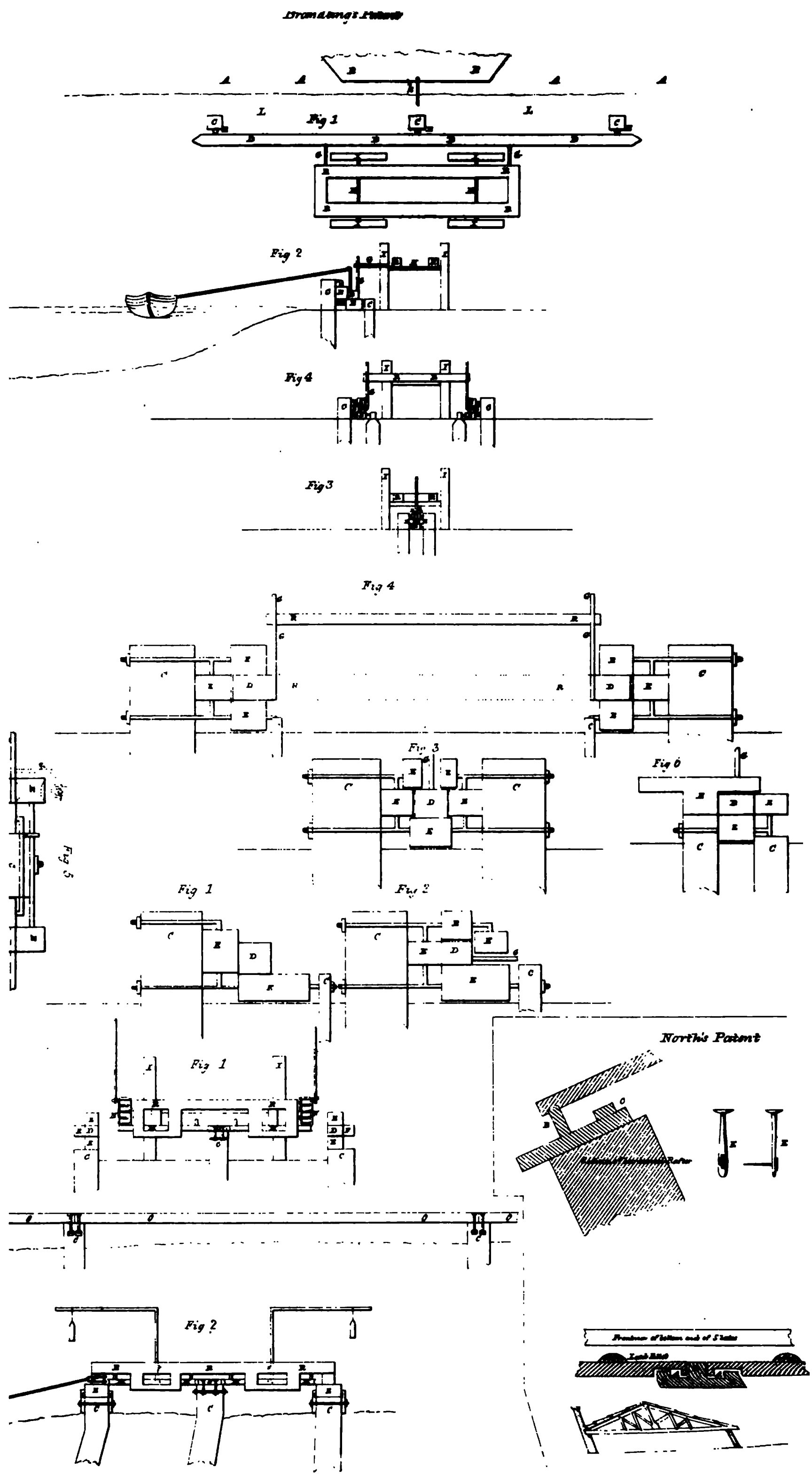


Fig 1
Fig 2
Fig 4
Fig 3
Fig 4
Fig 3
Fig 6
Fig 5
Fig 1
Fig 2
Fig 1
Fig 2
North's Patent

forms may be used, or the straight arm, fig. 3. In fig. 5, the endless rope may travel on the top retaining-rollers. In fig. 3, on the bottom ones. In fig. 4, the dotted line, R, R, connecting the two guides, converts them into a frame, by which the power of the retaining-rollers is increased by increasing the breadth of such frame. The lettering of this plan corresponds with that in plan No. 1, with the addition of F, which is a turnstile-wheel, part of this invention. This wheel, for strength and security, may in some cases be advantageously used.

Plan No. 3, fig. 1, compression-wheels, and lanterns and cogs, by which they are moved, which is one mode of allowing for their necessary motion in the groove attached to the frame which supports them. The guides and rollers are shewn unattached at the side. In some cases two rails might be used and one guide. M, M, compression-wheels. N, N, lanterns and cogs. O, O, O, resisting-rail. Fig. 2, compression-wheels, worked by levers and weights. They are attached to a frame moved by the friction of those wheels when turned by the engine. The whole is supported by the posts and rollers, and kept in a proper position by the means above described. In these plans the elevation of the lower and supporting-rollers above the surface of the ground, is evidently unnecessarily great. The guides or frames may be supported at any number of points by wheels travelling clear of the posts and rollers.—In witness whereof, &c.

Enrolled May 19, 1834.

Specification of the Patent granted to WILLIAM NORTH, *of Stangate, Lambeth, in the County of Surrey, Slater, for an Improvement in Roofing or Covering Houses and other Buildings or Places.*—Sealed January 29, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—

Now know ye that my said invention is described and ascertained in manner following (that is to say):

My improvement in roofing or covering houses and other buildings or places, partly consists in laying and retaining upon the wooden or iron rafters of roofs, slates or slabs of slates, each of which, with the exception of those used in the lower tier of all, is raised at its lower end by means of a fillet of slate, lead, or other metal, or of mastic compostion attached to the underside of the slate or slab, which fillet, excepting when laid on slates, or slabs of slates of uneven surface, is scolloped on its under side, more or less, as may be required, so as to admit air from without to the timbers of the roof, and to let steam, heat, and damp escape from within. My said improvement further consists in laying or retaining upon the wooden or iron rafters of such roofs, slates or slabs of slate, each of which, with the exception of those used in the upper tier of all, has attached to the top side of the upper end of each, a fillet of slate, lead, or other metal, or of mastic composition, smaller than the fillet before described, and the upper end of the slate, or slab, to which the smaller fillet is attached, being over lapped by the lower end of the slate or slab to which the larger fillet is attached, the smaller fillet excludes wet from without, while it does not prevent the air from being admitted to the timbers of the roof from without, or steam, heat, or damps, escaping from within, which completes the horizontal joints. Further, on the underside of each slate or slab, a groove is sunk at each side, the outer edges of which overlap the edges of a slate, or iron bearer, which has a corresponding groove sunk on each side of its upper surface, forming a channel for the discharge of wet that may get into the vertical joint.

And in order that this my specification may be sufficiently clear to enable competent persons, at the expiration of my patent, to practise my invention with the same advantage which I myself now possess, I shall describe the whole process of roofing, or covering houses, and

other buildings or places, in the manner which I practise.

Description of the Drawing.

The slates or slabs of slate are in thickness from $\frac{1}{8}$ in. to 1 inch, according to the strength required, in length from 2 feet to 6 feet, the breadth about two-thirds the length. On the underside of each slate or slab, is a groove at each of its sides about $\frac{3}{4}$ inch wide and $\frac{1}{4}$ inch deep, fig. No. 1, A, A.

On the underside of the lower end of each slate, excepting those used in the bottom tier, or eave course, is a groove $\frac{3}{8}$ in. and $\frac{1}{8}$ in. deep, into which is fastened a fillet of slate, lead, or other metal, about $\frac{3}{8}$ in. × $\frac{5}{8}$ in., by means of a seam of mastic or oil cement, having its bottom edge scolloped according as little or much ventilation is required, or not scolloped if the face of the slate upon which it bears is of uneven surface, fig. No. 2, B. And upon the upper side of the top end of each slate (excepting those used in the upper tier of all) is laid a fillet of mastic or other composition, or of slate, lead, or other metal, about $\frac{1}{2}$ in. wide $\frac{1}{4}$ in. thick, fig. No. 2, C: observing, that I generally use a fillet of lead for the bottom end, on account of its exposure to the weather, and its flexible quality in bending to the uneveness of the slate, and a fillet of mastic for the top end on account of its adhesive quality to the slate, and being partly protected from the weather. The bearers upon which the sides of the slates or slabs bear, forming the vertical joints, are of slate or iron, from 1 to 2 inches thick, of the same length as the slates, and about 3 inches wide, with a groove about $\frac{1}{2}$ in. wide and $\frac{1}{2}$ in. deep on each side of the upper face, fig. No. 1, D, D, D.

Method of fixing the improved roofing:—the wooden or iron rafters must be placed horizontally, of sufficient distance apart to allow of the top end of the slates having 2 inches bearing, and the bottom end to overlap the slate

below 2 inches, the principals or binders are about 8 feet apart. The slate or iron bearers are sunk and nailed at the upper ends, a sufficient depth into the rafters to allow of the slates or slabs bearing equally upon the rafters and upon the bearers, the bottom-end overlapping the head of the slate below 2 inches, and the sides of the slates or slabs overlapping the sides of the bearers, fastened at the bottom-ends with metal loops, E, E, countersunk into the face of the slate, and nailed to the rafters.—In witness whereof, &c.

Enrolled July 29, 1833.

Specification of the Patent granted to William Stedman Gillett, *of Guildford Street, in the County of Middlesex, Esquire, for certain Improvements in Guns and other small Arms.*—Sealed February 8, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said William Stedman Gillett, do hereby declare the nature of my invention, and the manner in which the same is to be performed and carried into effect, are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked (that is to say), according to the ordinary construction of fowling-pieces, muskets, rifles, pistols, and such like small arms, the hand which holds, and also fires the gun or pistol, is placed (with the exception of the finger which pulls the trigger), at or behind the breech of the gun or pistol. It consequently follows, when the barrel is long and heavy, it becomes desirable to increase the weight of the stock, in order to make the centre of gravity of the gun or pistol come as near as possible to the place where the hand

Gillett's Patent

Fig 1

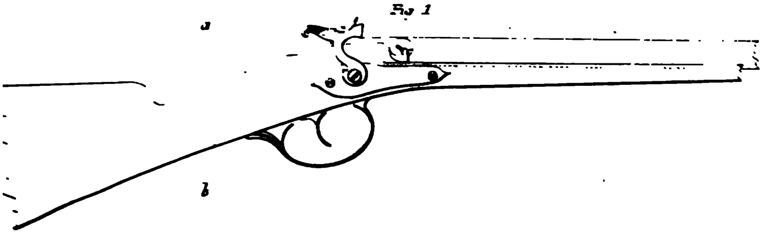
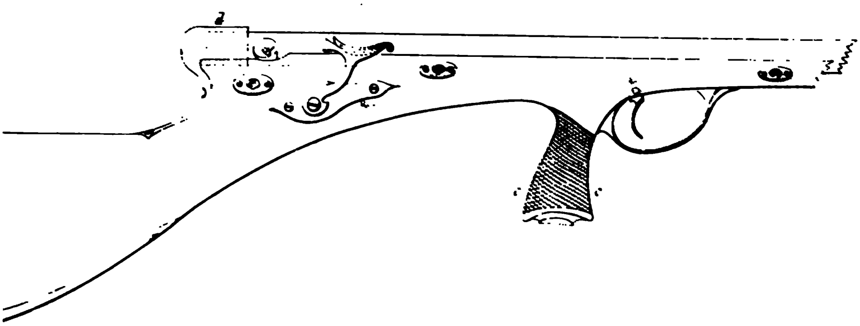
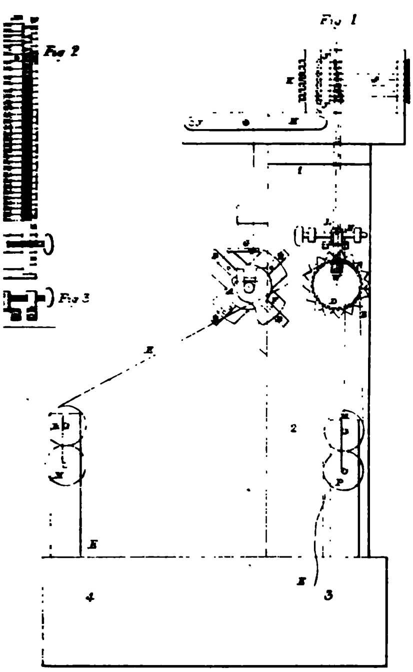


Fig 2



Gerard's Patent

Fig 1



Tomasa's Patent

Fig 1

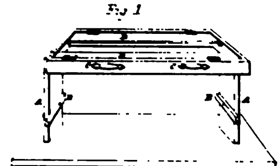


Fig 4 Fig 2 Fig 3

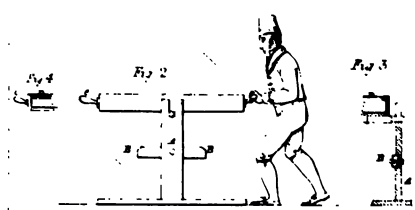
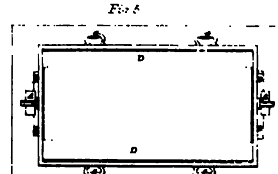


Fig 5



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(which fires) holds the gun or pistol, in order to facilitate, as much as possible, the raising the gun to bring it to point in the direction required. Where the stock is not weighted for the purpose of bringing the centre of gravity of the gun to the point where the firing hand holds the gun (that is, at or about the breech of the barrel), the weight of the barrel, particularly in heavy guns or pistols, requires considerable exertion in supporting them in the act of pointing when about to fire. By the words the "*hand which fires,*" I mean, under ordinary circumstances, the right hand in contradistinction to the hand which only acts as a rest, and usually the left hand. And it will be desirable here to remark, that by weighting the stock, as before mentioned, although it assists and facilitates the act of pointing, it nevertheless materially adds to the fatigue of carriage.

Now the object of my invention is to construct or mount the barrels of rifles, muskets, fowling-pieces, and other such like guns and small arms, in such manner that the hand which holds and also fires the gun or other small arms, is placed considerably forward of the breech, and approaches as nearly as possible to the centre of gravity of the barrel, the stock or but of the gun projecting only a short distance from the end of the barrel, and, consequently, not materially operating to vary the centre of gravity of the whole gun from the centre of gravity of the barrel, whereby I am enabled to produce guns and other small arms, having a given length and strength of barrels much lighter and more capable of being handled than when mounted in the ordinary manner, and at the same time a gun, or other small arm, when mounted or stocked according to my invention, will for a given length of barrel be much shorter than when mounted or stocked as heretofore, and by this means a gun of greater power, though but of equal weight with an ordinary fowling-piece, musket, or rifle, may be fired with much greater facility, at the same time it may be held with more firmness and

steadiness, whilst any oscillation caused by a slight involuntary movement of the hands, arm, or body (owing to the holding being considerably along the barrel), will not so materially effect the pointing, as when the hand which holds and fires is placed at a greater distance from the muzzle of the gun that is at or behind the breech as heretofore practised.

Secondly, my invention consists in applying a spring as hereafter described, for the purpose of permitting a longitudinal movement to the barrel.

In order that my invention may be most fully understood, I will now describe the drawing hereunto annexed.

Description of the Drawing.

Fig. 1, represents the outline of an ordinary gun, or fowling-piece, which I have drawn in order the more clearly to point out the object of my invention. The line, *a*, *b*, is the point at which the hand which fires grasps the stock, whilst the other hand is carried forward as a rest for the barrel.

Fig. 2, represents a gun mounted or stocked according to my invention. In this figure it will be seen that there is a projecting handle, *c*, considerably forward of the breech, and intended to be as nearly as possible at the centre of gravity of the barrel. This handle, *c*, is grasped by the hand which fires the gun, the trigger being in front of the handle, *c*, there being a connecting-rod attached to the trigger which connects it with the lock, as is shewn by dotted lines. The lock being of any ordinary construction, but in this instance its action is reversed, the cock striking in an opposite direction to that which is usual, and this is with a view to allow of the barrel having a movement lengthwise, there being a coiled spring contained in the socket, *d*, into which the breech of the barrel enters and slides when there is a strong recoil, the slits through which the pins, *e*, pass, allowing of such a movement, as is shewn by dotted lines

in fig. 2; but I only recommend such an application of a spring to guns firing ball, as muskets and rifles.

I have not thought it necessary to shew a drawing of a musket or rifle, as the manner of stocking or mounting such fire arms according to my invention, will be readily performed by a workman engaged in this part of the business; nor have I thought it necessary to shew a drawing of the mounting of a pistol stocked or mounted according to my invention; I would therefore remark, that there will be no but like those to ordinary pistols; on the contrary, the stock will only proceed to the breech of the pistol, the holding part or handle, *c*, being formed at or near the centre of gravity of the barrel, in like manner to the guns above described.

Having now described the nature of my invention, and the manner of carring the same into effect, I would have it understood, that I lay no claim to any of the parts of a gun or pistol, which are well known and in use; but what I claim as my invention is, the mounting or stocking of guns or other small arms in such manner that the hand which fires holds and supports the gun at or near the centre of gravity of the barrel, and, consequently, considerably forward of the breech thereof, as above described. Secondly, I claim the application of a spring, as above described, for the purpose of allowing a longitudinal movement to the barrel.—In witness whereof, &c.

Enrolled August 8, 1834.

Specification of the Patent granted to Jacques Francois Victor Gerard, *of Redmond's Row, Mile End, in the County of Middlesex, for an Improvement applicable to the Jacquard Looms for Weaving Figured Fabrics.*—Sealed October 19, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso,

I, the said Jacques Francois Victor Gerard, do hereby declare the nature of the said invention to consist in the substitution of paper for the pasteboard cards now used in Jacquard looms: and in further compliance with the said proviso, I, the said Jacques Francois Victor Gerrard, do hereby describe the manner in which the said invention is to be performed, by the following statement thereof, reference being had to the drawing annexed, and to the figures and letters marked thereon (that is to say):

Description of the Drawing.

Fig. 1, is a side-view of so much of a Jacquard loom as is sufficient to shew the apparatus required to be added to it for the purpose of substituting paper for the pasteboard cards hitherto used. Nos. 1, 2, 3, and 4, is a wooden frame. A, is the lanternon moved by the mantonet of the Jacquard. B, B, B, B, are four tappets acting upon the rachet-wheel, C; this rachet-wheel is attached to the cylinder, D, which cylinder must be as wide as the paper intended to be used, and must be furnished with a toothed band at each end, the teeth of which must take into holes pierced in the boarders of the paper for that purpose, so as to keep it in an uniform position. E, E, E, E, is the paper with the pattern read upon it, and it will be seen that the paper passes between the rollers P, M, the upper roller moving in a slot, and thus, by its weight resting on the lower roller, acting as a sort of detent-roller, to keep the paper straight. From the rollers, P, M, the paper passes over the cylinder, D, and thence between the rollers, R, M, by which arrangement it will be evident that if the paper be made exactly of the length required for the pattern, the two ends may be joined, and thus it will form an endless web whereby the operation of lacing which is required where cards are used will be entirely superseded.

In order to make so thin a substance as paper efficient

it is necessary to relieve it from the pressure of the needles as much as possible, and this is effected by means of the lever H, which turns on the pivot at J, and is moved up and down by the cams, F, F, F, F, on the tappit-wheel, striking the cross-bar, T, at the bottom of the upright-shaft, G; this lever acts upon the lifting-fram, J, J, and raises the set of pins, s, when required, above the grooves in the grooved block, K, or lowers them so as to pass into the grooves at pleasure: the block, K, thus answers the purpose of the pierced cylinder in the Jacquard loom. W, is the recess into which the needles, L, fall when the holes in the paper allow of it, and it will be seen that each of these needles is supported by the eye or loop at its upper parts, as here shewn.

Now it is evident that the paper, when used in this manner, will be liable to stretch and shrink according to the moisture or dryness of the atmosphere, and N, is an apparatus for adjusting the needles, L, so as to meet this difficulty; the position of it in the loom is here shewn, but its structure will be better seen by the figures 2 and 3, the former of which represents a plan, and the latter an end-view of the said apparatus, which I call the adjusting-beam; this beam is composed of fifty-one pieces, and each bored with eight holes: these pieces are moved nearer together or further apart by wedges, V, V, at each end of the perforated piece: these wedges are acted upon by the screw, Z, which has a right and left thread cut on it, as here shewn. There should be one of these screw at each end of the beam, and drawing the sides, *r*, *e*, of the beam together by means of these screws, forces a small tenant, projecting from the wedges, V, into a groove made for it in the side-pieces, *e*, *r*, and thus adjusts the pierced pieces, two of which in this figure are marked V.

Now whereas I do not confine myself to this particular apparatus for applying paper instead of pasteboard cards, because it may be done in many other ways, provided only that proper care is taken to avoid too much pressure

on the paper by the needles, and to provide for the stretching and shrinking of the paper. But whereas I claim as the said invention, the substitution of paper, as hereinbefore described, for the pasteboard cards now in use for Jacquard looms. And such inventiou being to the best of my knowledge and belief entirely new and never before used within that part of his said Majesty's United Kingdom of Great Britian and Ireland called England, his said dominion of Wales, or Town of Berwick-upon-Tweed, I do hereby declare this to be my specification of the same, and that I do verily believe that this my said specification doth comply in all respects fully and without reserve or disguise with the proviso in the said hereinbefore in part recited letters patent contained; wherefore I do hereby claim to maintain exclusive right and privilege to the said invention.—In witness whereof, &c.

Enrolled April 19, 1834.

Specification of the Patent granted to John Baptiste Constantine Torassa, *of Newington Causeway, in the County of Surrey, Gentleman,* Paul Isaac Muston, *of Austin Friars, in the City of London, Merchant, and* Henry Walker Wood, *of the same place, Merchant, for certain Improvements in Making or Producing the Pigment commonly known by the name of White Lead or Carbonate of Lead.*—Sealed December 11, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, we, the said John Baptiste Constantine Torassa, Paul Isaac Muston, and Henry Walker Wood, do hereby declare the nature of the said invention to consist in making or producing the pigment commonly known by the name

of white lead without the use or employment of vinegar, or acetic, or acetous acid, in any other form or under any other name, and without the aid of artificial heat, except for the purpose of drying the white lead, as hereinafter mentioned, by reducing the ordinary lead of commerce, by friction in water, to a very fine powder, and then exposing the said powder to atmospheric air, so that it may acquire both oxygen and carbonic acid, and thus be converted into the pigment aforesaid. And in further compliance with the said proviso, we, the said John Baptiste Constantine Torassa, Paul Isaac Muston, and Henry Walker Wood, do hereby describe the manner in which the said invention is to be performed, by the following statement thereof, reference being had to the drawing annexed, and to the figures and letters marked thereon (that is to say):

We cut common sheet-lead into very small pieces or grains, or, what is preferable, we form lead into what may be termed shot, in the same manner as patent shot is made, except that no other ingredient is used to cause the lead to cool in a perfectly round form. The exact shape of the pieces of lead is immaterial, but the shape of shot is the most convenient. These shots or pieces of lead should be about the size of *duck shot*, and having procured any given quantity, we place them in an open shallow wooden vessel lined with sheet lead, which we call a friction vessel, covering the bottom of the vessel with the shot or pieces of lead to the depth of about one inch, and then add water sufficient to cover them, but not more. We then tip the vessel containing the shot or pieces of lead, from side to side, in such manner as to cause the shots or pieces of lead to roll backwards and forwards on the bottom of the vessel, and thus produce great friction of the pieces of lead one against the other, and this friction will produce an extremely fine powder of lead mixed with the water, from which it will separate easily, if left to subside. We then remove the moist

powder, which is at an early period of the process of a dark colour, pass it through a fine sieve, and expose it for about eight or ten days to atmospheric air, whilst the powder is still in a moist state, and about the consistence of thick cream, in another shallow open vessel, which we call the carbonating vessel, where we agitate or stir it constantly, in order to expose it as much as possible to the action of the atmospheric air, until it assumes a beautiful white colour, and is thus converted into the pigment commonly known by the name of white lead or carbonate of lead. The carbonating vessel may be made of any convenient material, but we prefer wood as nearly colourless as possible. When the white lead is thus produced, if it should still contain any moisture, it should be well dried before it is put into casks for sale.

Description of the Drawing.

Fig. 1, is a perspective elevation of a friction-vessel, such as we prefer for the purposes of the said invention; it consists of a shallow box, or tray, lined with sheet-lead, turning on a shaft or axis passing under it, which rests at each end in a slot formed in an upright standard, as shewn at A, A; to these standards are fixed cross-pieces, B, B, which serve as stops to prevent the tray from ever tipping or dipping beyond an angle of forty-five degrees. C, C, are two handles, by which the front of the tray is moved up and down by the operator, the tray turning on its axis, as here shewn. D, D, are two flaps, or wash-boards, to keep the shot or pieces of lead and the water from spilling over, when the tray is in action.

Fig. 2, is a side-elevation of the same vessel, shewing how the operator stands to work it. The dotted lines shew the greatest angle at which the tray can be placed; and as similar letters are used to denote similar parts in all the figures of the drawing, no further description of this figure will be necessary.

Figs. 3 and 4, are sections of parts of fig. 2, fig. 3, being taken longitudinally, and fig. 4, transversely.

Fig. 5, is a plan of the friction-vessel. Of the carbonating-vessel it is only necessary to say, that a tub, or any other open and rather shallow wooden vessel, will answer the purpose.

Now whereas, we do not claim as the said invention the form of the friction or carbonating-vessels here given, or the particular manner hereinbefore described of agitating the lead, though the foregoing is the process we usually employ as being the best adapted of any we now know of for the purpose, when engine-power is not used; but we claim as the said invention the following improvements (that is to say), making white lead without the use of vinegar or acetic or acetous acid, in any other form or under any other name, and without the aid of artificial heat, except for the purposes of drying the white lead, as hereinbefore mentioned, and converting the ordinary lead of commerce into the pigment commonly known by the name of white lead or carbonate of lead, by reducing it to a fine powder by friction, as aforesaid, and then converting that powder into the said pigment by exposing it to the action of the atmosphere, as hereinbefore described. And such invention being, to the best of our knowledge and belief, entirely new and never before used; we do hereby declare this to be our specification of the same, and that we do verily believe this our said specification doth comply in all respects fully and without reserve or disguise with the proviso in the said hereinbefore in part recited letters patent contained; wherefore we do hereby claim to maintain exclusive right and privilege to the said invention.—In witness whereof, &c.

Enrolled June 10, 1834.

Specification of the Patent granted to Richard Holme, *of Kingston-on-Hull, Merchant, for Improvements in Apparatus and Means of Generating Steam, and in other Parts of Steam-Engines, and also in the Means of Producing Heat.*—Sealed November 5, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Richard Holme, do hereby declare the nature of my said invention, and the manner in which the same is to be carried into effect, are fully described and ascertained in and by the following descriptions thereof, reference being had to the drawings hereunto annexed, and to the figures and letters marked thereon (that is to say):

My invention consists, First, in improvements in boilers or apparatus used for generating steam; Secondly, in the method of applying certain apparatus for condensing steam; and, Thirdly, in apparatus for supplying fuel for the production of heat, whereby a more effectual combustion is obtained. In order that my invention may be most fully understood and carried into effect, I will describe the drawings annexed.

Description of the Drawing.

Fig. 1, represents the section of a boiler or apparatus for generating steam..

Fig. 2, is a plan (in section) of fig. 1.

Fig. 3, represents a section of the manner of fixing the tubes of which the flues from the furnace are composed. In each of these figures the same letters indicate similar parts; *a, a,* being the furnace or fire-place, which is supplied with fuel through the tubes, *b, b,* as will be hereafter described as the third part of my invention. c, *c, c, c,* is the boiler which contains the water, the part *d, d,* being a double casing which descends from the

Holmes' Patent

Fig 3

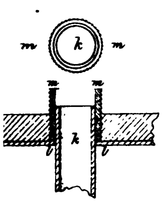


Fig 2

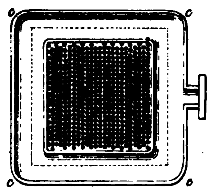


Fig 7

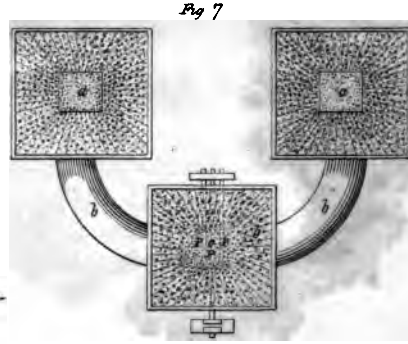


Fig 1

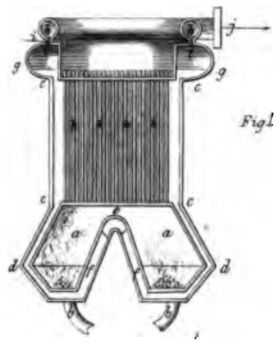


Fig 6

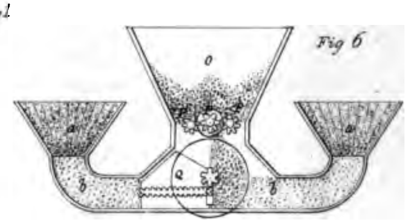


Fig 4

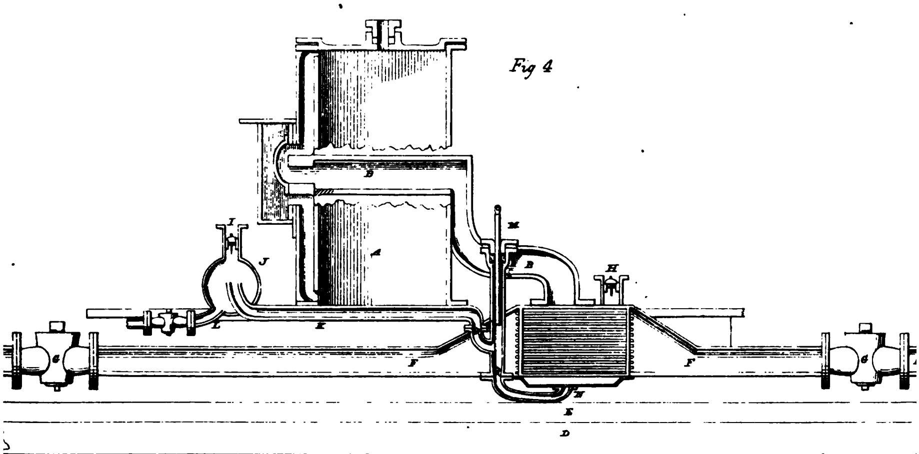
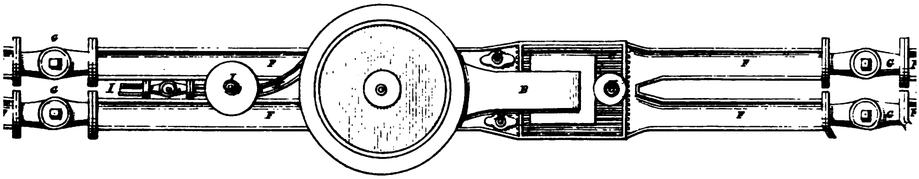


Fig 5



bottom of the boiler and surrounds the upper part of the furnace with water, as seen in fig. 1. *e*, is a curved tube leading from back to front of the boiler, and thus connecting the water-way, and which is further obtained by the pipes, *f*, *f*, the other part of the bottom having fire-bars to support the fuel, standing at an angle similar to the pipes, *f*, *f*. *g*, *g*, is the water-line of the boiler, which it will be seen is above the height of the tubes which constitute the flue; but the main feature of novelty in this boiler consists in the manner in which the steam is separated from the water in the boiler. *h*, *h*, is a tube or vessel at the top of the boiler, which acts as a steam-chest or reservoir; the steam from the surface of the water rises through a slit, *n*, all round, the area of which slit should be about the same as the eduction-pipe, *j*, by this means the rush of steam will not be only in one direction, but is diffused over an exceedingly long minute surface, and thus tends more effectually to separate the steam, and prevent it carrying over the water. I have not thought it necessary to shew the safety-valves, gauge, cocks, and other requisites of a boiler, they being well understood, and will readily be applied. The second point of novelty in this part of the apparatus is the manner of fixing the tubes, *k*, which constitute the flues. Fig. 3, shews a section of part of one of the tubes, *k*, which I prefer to be accurately drawn iron tubes, though I did not confine myself to that material. *l*, is a ring of lead, or other proper material, to act as a stuffing for keeping the joint water and steam tight. *m*, is a short tube which passes over the end of the tube, *k*, so that the tube, *k*, can pass up or down, and thus allow for expansion or contraction lengthwise of the tubes, *k*. On the outside of the short tube, *m*, is cut a screw which screws into the female-screw cut in the opening through which the tubes, *k*, pass; by this arrangement an air and water-tight joint is obtained. The other end of the tube, *k*, I prefer to screw into the bottom of the boiler, as it is

only necessary to give power of sliding in case of expansion or contraction at one end of the tube, *k*.

I will now describe the second part of my invention, that which relates to the method of applying certain apparatus for condensing steam from steam-engines.

Fig. 4, is an elevation, in section, of part of a steam-engine; and fig. 5, a plan of the same. A, represents the section of an ordinary steam-cylinder. B, being an eduction-pipe, from the eduction-way of the cylinder, such pipe passing round the outside of the cylinder, A, and thence to the condenser, C, which consists of an extensive series of tubes, placed in such a position as to be operated on by the cooling effect of a stream of cold water, passing from stem to stern of a ship or vessel, by the progress of the ship or vessel. D, represents part of the keel of a vessel, and E, the keelson. F, are two pipes leading from stem to stern, below the water-line of the vessel. G, G, are cocks or valves by which the stream of water may be shut off, or by this means the quantity of water permitted to pass may be regulated. H, is an air-valve, by which any air which may be contained in the body of the condenser, C, may pass off. I, is another air-valve, more effectually to get rid of any air which may be separated in the operation of condensing the steam. This valve, I, is placed on the vessel, J, into which the pipe, K, and the pipe, L, enter, and by which water is supplied to the boiler. This valve must be weighted to resist the pressure of the steam in the boiler. M, M, are pumps by which the water is supplied to the boiler.

Having now described the parts of the apparatus, I will describe the manner of action. On the opening of the cocks or valves, G, G, on the pipes, F, F, these pipes will become full of water, and fill the series of tubes, C, which constitute the condenser. The space on the outside of the tubes being opened only to the steam eduction-pipe, so that the condensing-water does not come in contact

with the steam, but effects its condensation by the cool surfaces of the tubes of the condenser. It will thus be evident, that on starting the engine, the progress of the vessel will cause a flow of water through the pipes, F, and also through the tubes of which the condenser is formed, and the steam, on leaving the cylinder, rushes through the eduction-pipes amongst the tubes, and becomes condensed, and the water flows through the pipe, N, into the force pumps, by which it is forced forward to the vessel, J, and thence to the boiler; and such will be the continuous operation of the apparatus, the condensed water being returned from time to time to the boiler.

Figs. 6, and 7, shew my third improvement, relating to the supplying of fuel for the production of heat, whereby a more effectual combustion is obtained. O, is a hopper, into which coal or coke is supplied. P, P, P, are three grooved rollers, placed at the bottom of the hopper, by which the coal or coke is alternately forced forward into the two parts of the furnace, *a*, and thus the fuel being at all times brought up from below, it will burn off at the surface, the smoke and gasses having to pass through the previously ignited fuel, produces a more effectual combustion, and tends to destroy the smoke. This piston, Q, may either be actuated by a mangle movement, or by a crank, or other well known means of producing a reciprocating action to the piston, Q, the piston having an angular top by which the coal or coke falls to the side to which the coal is next to be forced, and the middle rollers, P, is made to gear into the pinion of the side-rollers, P, alternately, one roller standing still at the time the other is assisting to supply the coal and coke.

Having now described the nature of my invention, and the manner of combining and using the same, I would have it understood, that I lay no claim to any of the parts separately, of which the same is composed, nor do I claim as new the application of a series of tubes for the

purpose of condensing the steam of steam-engines, nor do I claim the supplying fuel from below, these having before been practised; but what I claim as my invention, is, first, the application of the vessel, *h*, to a steam-boiler, such vessel having a minute slit or opening for the passage of the steam, whereby the rush of steam from the surface of the water is diffused over a considerable extent of surface, and thus tending to separate the water from the steam, as above described; and also for the particular method of fixing the tubes which constitute the flues, when the same is applied to steam-boilers or generators, and thus allowing of a longitudinal expansion or contraction, as above described. Secondly, in placing a condenser consisting of tubes, as above described, in a vessel, or pipes open to a flow of water, through a ship or vessel, as above described. And, thirdly, in the peculiar arrangement of apparatus for supplying fuel to two parts of a furnace by the reciprocating-piston, as above described, whereby a most effectual combustion will be obtained.—In witness whereof, &c.

Enrolled May 5, 1834.

LAW REPORTS OF PATENT CASES.

Court of King's Bench, Westminster, June 21, 1834, *before Lord Chief Justice Denman.*

JONES *v.* RIPLEY.

Sir J. Scarlett (with whom were *Mr. Cresswell* and *Mr. Rotch*) stated the plaintiff's case. He claimed to be the inventor of a machine for brushing cloth by a variety of processes. The cloth having been woven, cleansed, and scoured, the application of the plaintiff's invention begins. The cloth, after scouring, is submitted to the operation called burling,—picking out, by the hand, the parts that are lumpy. Before the plaintiff's

invention that was performed in this way: the cloth was laid on a large table, and persons, by the hand, brushed first one way and then the other, in order to raise the pile, to discover where the uneven parts were, which were then removed by a sort of tweezers. The first operation of the plaintiff's machine takes the place of that manual labour, and brushes the cloth more fully and speedily; the picking out remaining the same. The next process is the fulling, where the cloth is reduced in width in proportion as 12 to 7. It is then carried to the gig-mill formerly fitted up with teazles for the purpose of raising the pile and breaking the slender fibres that lie on the surface of the cloth. Then follows the shearing, during which operation it undergoes several brushings; then it is pressed, and, finally, again brushed. Cloth is brushed at several stages of the manufacture, and much oftener since the plaintiff's invention.

The piece of cloth being of great length there is a difficulty in taking up one end, and to carry it smoothly and correctly to brush it, without any application of the hand to it. For this purpose the Yorkshire machine was carried to great perfection. Brushes were applied to a roller, and over that the cloth was thrown; the cloth then passed through a frame, which was made to swag backwards and forwards, for the purpose of throwing the cloth down in folds. The cloth was then to be taken up to be carried above the rollers, by the hand, and in moving it it required to be turned upside down, that the proper end might be presented: that required the labour of two persons. The plaintiff, instead of the swagging-instrument uses an inclined plane, on which the cloth descends, and by its weight, comes down with the proper end to be taken up by the other machine.

The patent is for "an invention of certain improvements in machinery and instruments for dressing and cleansing woollen, cotton, linen, silk, and other cloths or fabrics, which improvements are also applicable to the dressing

and cleansing of machinery of various descriptions, and other articles or substances." From the specification, it appears, the plaintiff has thrown together various things, the combination of which he claims as an invention of a new machine of great utility. (The learned counsel then, by means of drawings and models, described the construction and manner of operation of the plaintiff's machine.) The old machine occupied an area of 100 square feet, was as high as the ceiling, and required large premises. The plaintiff's machine need hardly be larger than the model produced in court, and several might be in one room. The brushes instead of being perpendicular, are placed at obtuse angles, and, therefore, when brushing, yield gently to the cloth: by this means wires were capable of being intermixed with the bristles. The machine also whisked the cloth without the use of the hand; and the back of the cloth was also brushed by the same operation: the brush is also employed to clean the machinery itself.

The plaintiff sold some thousands of these machines, besides which, having licensed many persons to improve their own machinery with his invention. The defendant (who, as well as the plaintiff, resides at Leeds) purchased one of these brushing-machines, with which they were so well pleased as to order a burling-machine, and sent persons during its progress to take the dimensions of it, but did not ultimately have it. Two years after this, the plaintiff discovered that the defendant had made a burling-machine from the dimensions then taken, and had also applied to their own machine the plaintiff's inclined plane. For this infringement the action was brought, attempts at negociation having failed.

William Davis, a machine-maker, on being called, explained the construction of the West of England and Yorkshire machines, of which models were in court; and then described the mode of operation as performed by the plaintiff's machine, of which a model was also produced.

He proved that he had made a great number of them himself, and that they were very generally in use in the clothing districts; that it caused a great saving in manual labour, and that the process was performed in a much superior manner.

On cross-examination by *Mr. F. Pollock*, he admitted that in the specification no dimensions were given; he thought it unnecessary, the thing being so well known. All cloth is not the same width, varying from 78 inches to 12 feet, and the brushes to the plaintiff's machine are made with bristles or bristles and wires intermixed; the manufacturers generally order, themselves, the kind of brush they wish to have; witness had a machine for brushing cotton with brushes made of wires and bristles intermixed; the proportion of bristles is according to the work it has to do; the angle at which the bristles or bristles and wires are fixed, depends upon the nature of the fabric for which it is intended; the wires that are laid most down have the least effect on the cloth; the angle is not necessary in all cases; both the cylinders in the model were fitted with the brushes having bristles and wires intermixed; would not swear he had made any machines with wires in both cylinders.

Re-examined by *Sir J. Scarlett*. Plaintiff's patent brush of 1818 is well known in the West of England and Yorkshire; the degree of strength required would be according to the fabric, and the manufacturer would order accordingly; the perpendicular brush acts more powerfully in raising the pile. Plaintiff's patent of 1818 was for raising the pile before shearing; it is applied to the cylinder of the gig-mill in the same way as the teazle; the application of the brush will cleanse the machinery itself.

Mr. Pollock then took several objections to the plaintiff's specification. In the first place, the patent was taken out for a machine applicable to the cleansing machinery, and not a single word in the specification pointed

out in what manner that could be done. In the next place, the machine invented is professed to be described entirely. A claim was made for setting the brushes at obtuse angles, and yet neither cylinder B, nor cylinder C, in the drawings and models, had these obtuse-angled bristles. The third objection related to the patent which the plaintiff took out in 1818, for "an improvement in certain parts of machinery or instruments used for the dressing of woollen and other cloths." The specification of that patent distinctly communicated to the public a description of brushes made of bristles and wires intermixed, which brushes were applicable to the cleansing of machinery; therefore the plaintiff could not take out another patent for the same purpose. The plaintiff was bound to tell the public the proportions, which he has entirely omitted in his patent of 1824, and not leave them to make experiments, because as the matter was new no man could bring experiment to the subject. If he had found it answered it must have been within some limits or some definite proportion, and that proportion he was bound to state to the public. It was necessary in 1818, and there he did state it; it was necessary in 1824, and there he did not state it. From the words of the two specifications, it was clear they referred to the same description of subject, and the plaintiff was seeking to extend to himself the benefit of a patent which expired in 1832, six years longer, namely, 1838.

Mr. Milner was heard in support of the objections.

Sir J. Scarlett was heard in answer to the objections. Against the first he argued that a machine already known cannot become the subject of a patent merely because you apply it to a purpose for which it was not known before, unless something new is introduced into the combination. Whether the original inventor says it is "applicable to various other purposes," or omits the statement, it makes no difference: many persons, who find the machines applicable to purposes which they did not contemplate, in-

troduce those general words to shew that the machine is applicable to a greater variety of purposes than they have stated. To the objection that the brushes were not sufficiently described, the learned counsel replied, that the plaintiff did not claim the combination to make the brushes, but left it to the judgment of the party using the machine; the machine would do either with bristles and wires, or bristles alone: it rests with him, also, as to what degree of obtuseness he will have the bristles or bristles and wires placed. With regard to the objection as to the former patent, the brush claimed now as original was not the brush contained in the former specification; all the plaintiff claims is the construction of a brush with the bristles at an angle. If he had said nothing about it it would have been objected that he had set forth something as new that was known before, and that he left people to find out what he had described in his former specification. In the specification of 1818 not a word was said about an angle, the brushes there were all ordinary brushes set at right angles, or set with angles in all directions. The patent was not a renewal of that of 1818, but simply stated that the brushes now claimed are brushes made in this particular form, and not those claimed in the patent of 1818.

Mr. Cresswell and *Mr. Rotch* followed *Sir J. Scarlett* in answer to the objections; and *Mr. Pollock* briefly replied, recapitulating his objections.

Lord Denman.—This is a patent which appears on the evidence to have been of very considerable value, a great improvement in the machine; but it is obvious on the face of the patent and the specification, in connexion with the evidence given, that there is no useful invention for which the plaintiff has entitled himself to the patent by describing it properly in the specification. As the patent is claimed for dressing and cleansing machinery. I should certainly have thought it essential that the specification should have said something as to the mode

in which machinery was to be dressed and cleansed; it does not appear, from the beginning to the end of this matter, that it is set forth in the specification. The patent is certainly claimed for that as well as other objects, but the mode in which that object is to be effected, does not appear. But I think there is a still stronger objection. It is stated in the argument for the plaintiff, that the setting the bristles upon the cylinder at obtuse angles is considered as the very point of value of the invention, and yet in the whole course of the description the obtuse angles are never mentioned as part of the things which he claims. It may appear on the drawings to be at obtuse angles, though it requires some minute inspection to discover it, but it is not stated in the description; it is not stated in what way that is valuable, or an improvement on former machines of the same nature. But it also appears on the evidence, that obtuse angles are in no way essential in doing the work they are required to do: the very thing that is stated as useful, as the valuable principle in the improvement, turns out, on the evidence of the scientific witness who is called, to be perfectly immaterial for performing the operation required. It appears to me the very foundation of the invention fails, according to this description. There is that unfortunate dilemma from which the plaintiff cannot escape, that in the first place it is extremely ambiguous and very difficult to know, precisely, what it is that is claimed by this language; but supposing it to be clear, and that the mode at which they are said to be placed at obtuse angles is an essential part of the principle on which the invention is said to be valuable, then it seems to me to be proved by the plaintiff's witness, who understands it thoroughly, that the setting or drawing at obtuse angles has nothing to do with the brushing, or moistening, or cleansing woollen or other fabrics, any more than if they were set at no angle at all. Therefore I think there is no valuable in-

vention set forth on this specification as connected with the evidence. I must say it appears to me, in connexion with this evidence, that it is hardly possible to say the patent is not for the very same invention described in the former patent. I do not enter minutely into that, but it does appear to me that is the effect; and if the present machine is protected by the patent which was granted in respect of it that that former machine would actually fail. In point of fact, the party is claiming an extension of that point six years beyond the period he has a right to claim; and I think, therefore, I am bound to call the plaintiff.

The plaintiff was then nonsuited.

In our last Number, we called attention to the case of *Minter* v. *Wells and Another*, with a view to shew to all parties interested in patents, that where an inventor observes due care in drawing up his specification, the law will give him every protection. The present case (*Jones* v. *Ripley*) offers a still stronger lesson to inventors;—it points out to them that ambiguity, as to what is claimed as new and the invention of the patentee from that which is old, will at all times be prejudicial to a patent.

Till within a few years, the greatest possible negligence is evident in the larger portion of specifications. The same observation applies to many of the present day, though we must take credit to ourselves that we have, by our publication, materially advanced a knowledge of the law of patents, and, at the same time, have raised in the minds of patentees a just confidence that those laws will give every protection, provided the inventor be honest to himself and to the public. Mr. Jones's specification describes, in general terms, the machinery shewn in the drawing: it does not appear, by the description, that such brushes were ever used before for similar purposes, yet this ought to have been mentioned, —there is no claiming or disclaiming; consequently, an

individual reading over the specification must suppose that the whole is new and claimed by the patentee.

We would remark, that in all cases where a patent is taken out, *the inventor must know where his invention commences and where it stops;* this he should point out in his specification, and disclaim all the parts described which are not his invention: in the absence of such information, other inventors, as well as the public in general, cannot know how much is secured by a particular patent; and this they have a right to be informed, and it is for this purpose the specification is required by law. We have no doubt that there are several points in Jones's specification, which might have been safely claimed as new, and which would have constituted a valuable patent, whilst it is evident that much ought to have been disclaimed. There is then the fatal objection of the patent being taken out (amongst other things) for "cleansing machinery of various descriptions;" but in the specification no notice is taken of this part of the invention. EDITOR.

PROGRESS OF SCIENCE

APPLIED TO THE ARTS AND MANUFACTURES, TO COMMERCE, AND TO AGRICULTURE.

ON A CLOCK FOR GIVING MOTION IN RIGHT ASCENSION TO EQUATORIAL INSTRUMENTS: BY THE REV. R. SHEEPSHANKS.—The usual mode of measuring the distances and angles of position of double stars, or the diameters of planets, is, to give a motion in right ascension to the whole instrument with one hand, equivalent to the apparent motion of the heavens, while the micrometer is managed with the other. The whole difficulty of the manual part of the operation consists in giving the former of these motions; for if by one hand we could *exactly* give the motion of the heavens, the management of the micrometer would be identical with the use of a circular protractor with one hand. The higher the magnifying power of the telescope, and the larger the instrument, the more troublesome, of course, it is to give this most delicate motion. It

is probably owing to a difficulty of this kind, that Sir John Herschel found "that the disuse of this species of observation for three or four years, had so far impaired his habit of exact measurement as to deprive him for some time of confidence in his results," and that the measures of distances are less satisfactory than those of position.

At first sight it might be thought that the increased difficulty of manipulation which accompanies an increased size of the instrument, depended solely on the greater magnifying power. This is by no means the case. The hand, it is true, in a large as well as a small instrument, is capable of giving a tolerably smooth and regular motion for about half a revolution of the wrist, after which it must be relieved; but this motion must be communicated to the hour-circle by a handle and Hook's joint. Now the Hook's joint does not *transfer* an equable motion, unless the tangent-screw and the handle are nearly in the same straight line; a condition obviously impossible in a large instrument, except for a small portion of the heavens. Hence the observer is required to humour the instrument, and accommodate his hand to the compounded motion of the heavens and the Hook's joint, which will be different in almost every situation. The increased weight and flexibility of a long handle adds very materially to the difficulty.

But this is not all, nor the worst consequence of greatly increased dimensions. When one hand is exhausted, in giving the motion in Æ, the other must be immediately brought from the management of the micrometer to its aid, in order to continue the motion, otherwise there will probably be a bobbing or rocking motion given to the whole machine, arising from the *inertia* of the mass. It seems almost unnecessary to do more than advert to this obvious consequence of increased magnitude; but as the subject is one of primary importance, and as upon this point the necessity of clock-work motion for large equatorials mainly rests, it is proper to explain it very briefly.

Matter when at rest requires force to put it in motion, and matter once put in motion requires force to stop it; in either case the matter does not move or stop until a sufficient force is brought into action. When the matter is movable about an axis, the force required for moving or stopping its motion is proportional to a quantity which is called the "moment of inertia." This moment of inertia is estimated by the quantity of matter multiplied into the square of the radius of gyration. Now in similarly constructed instruments the quantity of matter is as the cube of the linear dimensions; and the radius of gyration is as the linear dimension; hence, the moment of inertia varies as the *fifth* power of the dimension. Thus, if there were two equatorial instruments similarly constructed, one of which was four times as large as the other, the moment of inertia in the one case would be more than 1000

times that in the other. It is certain, therefore, that after any change from motion to rest, or *versâ vice*, the tendency of the instrument to shoot beyond, or to lag behind its proper place, would be a thousand times greater in the large than in the small example; and it is almost certain, that no clamp or strength of framing could resist this tendency to produce oscillation or tremor in a stand of such colossal dimensions as would be required for the large refractors now constructed, and in the telescope itself.

From these remarks it seems to follow, that if a large equatorial is to be successfully used by hand, not only must one hand be perpetually employed in giving a uniform motion by varying and uniform means, but that after every half revolution of that hand, handle, and tangent-screw, the other hand must be withdrawn from the micrometer to keep up the motion until the former can resume its grasp.

Whether, with all these precautions, the operation could really be performed with high magnifying powers, it is difficult to predict. The perfect education of both hands, and the subordination to the eye and judgment required for giving a smooth and equable motion in right ascension, would be a hard lesson to learn, and yet the attention must be left perfectly free for the purpose of actually measuring the angle of position and the distance of the stars. If clock-work can be applied to give this uniform motion in Æ, without injuring the performance of the telescope, it evidently reduces a great difficulty to a very simple operation.*

The essential qualification of a clock for moving an equatorial, is, that it should go *smoothly*. It is comparatively of little importance that it should be well-regulated, provided the variations in the rate are not such as to cause any jerk or tremor in the telescope. Hence, almost any train of well-cut wheels with a heavy fly-wheel and a fan for regulating the velocity, would, I believe, answer the purpose of a clock-movement in Æ, for the measurement of double stars. By a little care in proportioning the weight and the fan, it would be easy to bring the rate tolerably near—to one hundredth of the truth. There would, therefore, be a small, and, it might be, a varying motion, which is to be corrected by moving the whole of the eye-piece, micrometer and all, that quantity each minute. Now this is precisely the same thing as giving a direct motion by the fine screw carrying the eye-

* In the description of the large equatorial at Dorpat by Fraunhofer, Professor Struve says of the clock movement, "A main use of the clock is for measurements with the wire micrometer, since by it the diurnal motion of the heavens is destroyed, and the measures taken as if the heavens stood still. This is an invaluable advantage. The convenience of an equatorial movement and clock-work is evident for observing emersions of stars behind the moon," &c.

piece, without a Hook's joint to an instrument of 100dth part of the magnifying power, and is therefore easy enough; and if the hand does for a moment forget its duty, there will be no bobbing or rocking. With a little attention to the clock, the star is easily kept in the best part of the field. A moveable or slipping piece, pressed by a screw against a spring, instead of the fixed eye-end, is all the addition to the ordinary fitting up of the telescope that is required; and the motion of this is as smooth and within command as that of the micrometer itself. Such an addition to the eye-end is convenient, and perhaps necessary, wherever clock-work is to be applied.

A clock of this kind, but with every disadvantage of workmanship, contrivance, &c., I have applied and used; and so far as the limited power of the telescope would allow others as well as myself to form an opinion, with perfect success. (The telescope was a good 3½ feet, with a magnifying power above 100.) It may,. therefore, be considered as proved, that a smooth motion communicated to a tangent screw, will produce a smooth motion in a properly constructed polar axis of very large dimensions; and besides the trial above alluded to, which was perhaps as unfavourable and coarse as could be imagined, I may add, that I was informed by Sir J. Herschel, that he had given a tolerably satisfactory motion to his 7-feet equatorial, with machinery of no higher pretensions than could be made out of a worn-out smokejack. But such a movement as this, though incomparably better than the unassisted hand, is deficient in one respect, viz. in *regulation*, or keeping a uniform rate. I know but of two attempts which have been made to produce a *uniformity of rate*, one by M. Gambey of Paris, and the other by Fraunhofer.

The construction of Gambey may, perhaps, be understood by the following description :—Take a very powerful half-seconds clock, that is, a clock possessing a much more powerful spring or going-weight than is needed for the performance of the clock. Now if the tangent screw of the equatorial were attached to one of the arbors of this clock, the instrument would go *regularly* but not *smoothly;* it would receive a small motion every half-second, with a following rest, and (leaving out of view the subordinate oscillations produced) the stars would appear to move forward for half a second and then skip back perpetually. It would therefore be quite impossible to use such an instrument, which would be in continual agitation and tremor. M. Gambey, therefore, instead of attaching the arbor of the clock *directly* to the tangent screw, attaches it to one end of a spiral spring, the other end of which is fixed to the circumference of a toothed wheel, which in other respects revolves freely upon the same arbor. This toothed wheel moves the tangent screw of the equatorial. It is evident that the clock, when going, coils the spiral spring, and it coils it ever until

the toothed wheel gets relief by moving the tangent-screw. The variation of force upon the tangent-screw, when the whole is in motion, is only equal to the additional coiling of the spring by the motion of the arbor in half a second, which may be made insensible.

The construction of the clock-work applied by the celebrated Fraunhofer to Professor Struve's telescope is, in principle, scarcely different from that which is described hereafter. In the Dorpat telescope, the train of wheels gives motion to a horizontal flyer, through which again motion is given to the tangent-screw of the equatorial. The *regulation* lies wholly in this flyer. Conceive a cross-piece fixed on a vertical axis, and to each end of this cross-piece an arm to be attached, turning upon a joint, and carrying a bob at its extremity. The arms are not allowed to turn round so far upon the joint as to be a continuation of the cross-piece; there are springs adjustable with screws, which, pressing at their shorter ends, keep them inclined at an angle. When the machenary is put in motion, the vertical axis turns round, carrying the cross-piece; and the bobs, on account of the centrifugal force, extend the arms which carry them. A sort of cover, not unlike an extinguisher, is brought over the balls, against the inner surface of which they rub, and lose all extra force, and by raising or depressing the vertical axis within the extinguisher, the rate can be altered at pleasure. In the actual construction of the Dorpat equatorial, the tangent-screw does not carry the instrument, but is assisted by a counterpoise weight.

The clock * which I propose to employ for carrying a large equatorial, has been executed by Mr. Simms, partly at my suggestion, and will be easily comprehended. A train of wheels carries a *governor*, the same in every respect as the ordinary governor of a steam-engine. The balls, when extended, elevate a well-turned collar. This collar raises a lever, movable upon a fulcrum, by means of two opposite pins closely fitted into a groove in the collar. A second lever, movable round a fulcrum, is attached by a connecting-rod, which can be shortened or lengthened at pleasure by turning a screw-head. When the balls are at the proper elevation, the other side of the second lever presses upon a wheel which is carried on the arbor of seconds, and by its friction prevents any increase of rate.† There is a scale, upon which may be marked the

* This clock was exhibited, and the power and steadiness of its motion shewn, at the meeting of the Astronomical Society on the 11th of April last.

† Friction has been objected to as a regulating power, but, as it seems to me, from not duly considering the problem to be solved. In a machine for the purpose required it is a matter of no moment what quantity of power is thrown away, provided the motion retained be uniform; the object is to get a smooth and

position of the lever when going sidereal, solar, lunar, or other time, to any of which the clock is adjustable at once by turning the screw already mentioned.

The graduated circle is fixed by friction to the minute arbor, and revolves with it, so that the seconds of the equatorial clock may be set at once to the standard clock, and a clicking-spring is fixed on the second's arbor, which may easily be put in to beat with the standard. If wanted, minute and hour circles might be added. A going-spring is applied, so that there is no stoppage in winding.

It is proposed to attach the end which carries the tangent-screw of the equatorial to the arbor of minutes, which, however, requires the wheel-work above that arbor to be very truly made; or the motion may be transferred by a worm on the arbor of seconds, the regularity of which depends solely on the truth of the bevel-wheels, as the governor must necessarily revolve uniformly. The double lever is exactly counterpoised by a balance-bob.

By making the attachment of the connecting-rod nearer to the fulcrum, or by increasing the radius of the wheel carried on the arbor of seconds, the action of the break may be made just what we please; but I believe the clock here described is nearly as insensible and steady under alterations of weight and work as can be wished.

The largest and heaviest equatorial I have ever seen, was moved, as well as I remember, by a force of about 12 lbs. applied at the hour circle, and the diameter of the hour circle being four feet, we may take the force required to carry such an instrument to be 12 lbs. descending six inches per hour, or one pound descending 72 inches in the same time.

The weight of this clock falls about four feet in an hour, hence if we conceive the friction of the tangent-screw to be nothing, a weight of 1½ lbs. on the clock would carry the equatorial above alluded to.* Now two pretty careful trials have shown me that the addition of a weight of 12 lbs. accelerated the clock three seconds per hour, and a weight of 28 lbs. accelerated it seven seconds per hour. Hence 4 lbs. alteration in weight or work alters the rate only one second per hour;

regular motion, at any cost, not to regularise and make the most of a given supply of power. Additional wear is not worth consideration; and there are many reasons, both of convenience and accuracy, why the clock should be at all times far above its work.

* As it is only a *variation* of weight, friction, resistance, &c., that is to be guarded against, I conceive, with proper care, and abstracting unnecessary sources of error, such as bad balancing of the instrument, rough handling, exposure to gusts of wind, &c., this variation cannot be estimated to be more than a very few ounces added to or subtracted from the moving weight of the clock.

the duty, therefore, of carrying the large equatorial above alluded to would not alter the rate 0ˢ,5 per hour, excluding friction. If the clock were very nearly rated by the lever apparatus, the addition or subtraction of weights would afford a very delicate means of completing the adjustment to time. The gain of the clock in these trials was so uniform and regular as to lead me to imagine that it might be used for short intervals as a journeyman.

The motion is to be transferred from the clock to the tangent-screw of an equatorial by a rod and Hook's joint. The rod is formed of one tube working for a little space within another tube, and the friction between these may, by screwing a nut, be made any quantity required. In use it would be proper that this friction should be great enough to insure the motion of the tangent-screw when carrying the instrument, yet not so great as to resist *violently* by turning the tangent-screw by hand in order to bring the star into the best portion of the field. With a little practice, any defective setting for the star would be corrected very nearly by a single touch of the tangent-screw.

The final bisection would be then completed by the motion of the eye-piece in right ascension, and the observer be enabled to make his measures with great ease, I conceive almost, if not altogether, as satisfactorily as if the stars were immovable.—*Proceedings of the Astronomical Society.*

ON THE PROBABLE FUTURE EXTENSION OF THE COAL-FIELDS AT PRESENT WORKED IN ENGLAND. BY THE REV. W. D. CONYBEARE, M.A., F.R.S.—[Continued from vol. i. p. 403.]—I have already pursued my proposed examination through a considerable proportion of the coal-fields of our central district (namely, the eastern division, including the fields of Ashby-de-la-Zouch and Warwickshire, and the smaller patches near Ashborne on the south of the great Derbyshire chain). I consider the general result to be, that throughout this central district, the whole stratification is so extremely disturbed and undulating, that we are scarcely able to form any anticipations as to the probable prolongation of the beds, which can be at all relied upon; but that in very few instances the boundaries of the fields have as yet been ascertained with anything like scientific exactness; that a survey undertaken expressly with a view to this inquiry, is undoubtedly very desirable; and that it is little to the credit of a nation like ours, so peculiarly dependant on this branch of her mineral resources, that we thus continue contentedly to acquiesce in a state of ignorance so easily removed. We here see a strong instance of our want of a regular school of mining, such as is possessed by many other countries.

In continuing my own imperfect hints with a view to such ulterior

inquiries, I shall first complete the central districts, by noticing the Dudley coal-field.

Dudley Field.—The boundaries of this field can hardly yet be considered as accurately ascertained. The anticlinal ridge of transition limestone of Dudley throws up the beds which crop out all round it; and as on the eastern edge of the field near Walsall, the same transition limestone again emerges, we may consider the coal-measures around Bilston as lying in a trough between these points. I do not find any account of the exact limits of this trough on the N.W. border from the Dudley limestone range to Cannock, at the northern apex, or on the N.E. from Cannock to Walsall; but I rather believe that the beds crop out in these directions; so that we cannot in these quarters look for any probable extension. Not so, however, with regard to that portion of the coal-field which, ranging beneath the overlying basalt of the Rowley Hills, extends to the west and south-west of Dudley: here from Wolverhampton to Stourbridge the beds dip beneath the new red sandstone in a westerly direction, and pursuing that course about 10 miles we see the coal-measures again emerging from beneath this investiture around Over Arley in Shropshire. *The western border of this Dudley field, and the eastern border of corresponding Shropshire fields ought to be carefully examined, as it seems very probable that the strata may here extend continuously within workable depth.*

Indications of coal at the foot of the Bromsgrove Lickey.—These are so exceedingly shattered and disturbed as to afford very little prospect of leading into any valuable working districts.

Coal-fields of Northern Staffordshire.—These, which follow in order the patches near Ashborne, mentioned in my last (vol. i. p. 402), consist of two detached fields, lying against the S. W. corner of the great Derbyshire Penine chain: 1. The field of Cheadle, ranging along the river Churnot, described by Farey as a detached basin reposing on the millstone grit; and, 2. The pottery coal-field of Newcastle-under-Line, occupying a triangular area extending to Congleton on the north. From the eastern and western sides the beds dip towards the centre: but we are not informed in what manner they are disposed along the southern base of the triangle by Newcastle: as they are here overlaid by the new red sandstone, their prolongations may very possibly be traced to some distance beneath. *This portion requires re-examination.*

Great Manchester coal-field.—This field, reposing against the western slope of the Penine chain, ranges from Macclesfield to the east of Manchester, and then curving to the W. and S. W., extends nearly to Liverpool. The public is not yet in possession of any scientific description of this most important field; but recent

announcements promise that this desideratum will be shortly supplied. As this coal-field approaches near to the æstuary of the Mersey, where it dips beneath the new red sandstone, and as along the western border of the almost contiguous æstuary of the Dee, the coal-measures again emerge, skirting the whole Flintshire coast of that æstuary, I am persuaded that they will hereafter be found to extend continuously, and within a workable depth between these points. *The whole peninsula of Wirral may be expected thus to afford a productive coal-field: this is probably the most important accession which we can look for of the fields already worked.*

North Welsh and Shropshire coal-fields.—The Memoirs of Mr. Murchison promise to afford important additional information concerning these districts. I have already in this communication indicated their probable eastern extension, viz., of the Flintshire coal-field to join that of Lancashire; and of the Shropshire field, near Bridgenorth and Over Arley, to join that of Dudley. With regard to the north-western coal-fields, as we approach the Cumbrian mountains, or lake-district, that of Ingleton on the south of the carboniferous limestone encircling this group appears to constitute a small basin reposing on millstone grit, the shattered tract extending hence eastwards to Giggleswick; and the immense faults which traverse this district have been admirably described by Mr. Phillips (Geological Transactions, New Series, vol. ii.).

On the northern border of the Cumbrian mountains, from Whitehaven on the western coast, to Ravensworth, where the Cumbrian and Penine chains inosculate, on the east, a regular zone of coal-measures appears to succeed the carboniferous limestone, and though the principal workings are at the two extremities, indications have been found at various points between these fields; hence we may hereafter look for a considerable extension beneath the new red sandstone of the Vale of Eden.

In my next communication I propose to conclude these remarks by a similar notice of the south-western coal district.

Report on the Progress and present State of our Knowledge of Hydraulics as a Branch of Engineering. By George Rennie, Esq., F.R.S., &c. &c.—Part 1.—The Report of which the following is a part, has appeared in the recently-published "Report of the Third Meeting of the British Association for the Advancement of Science; held at Cambridge in 1833." We purpose to present our readers with the whole of Mr. Rennie's review of the history of hydraulics, as applied to engineering, in successive extracts.

The paper now communicated to the British Association for the Advancement of Science comprises a Report on the progress and

present state of our knowledge of hydraulics as a branch of engineering, with reference to the principles already established on that subject.

Technically speaking, the term hydraulics signifies that branch of the science of hydrodynamics which treats of the motion of fluids issuing from orifices and tubes in reservoirs, or moving in pipes, canals, or rivers, oscillating in waves, or opposing a resistance to the progress of solid bodies at rest.

We can readily imagine that if a hole of given dimensions be pierced in the sides or bottom of a vessel kept constantly full, the expenditure ought to be measured by the amplitude of the opening, and the height of the liquid column.

If we isolate the column above the orifice by a tube, it appears evident that the fluid will fall freely, and follow the laws of gravity. But experiment proves that this is not exactly the case, on account of the resistances and forces which act in a contrary direction, and destroy part of, or the whole, effect. The development of these forces is so extremely complicated that it becomes necessary to adopt some auxiliary hypothesis or abbreviation in order to obtain approximate results. Hence the science of hydrodynamics is entirely indebted to experiment. The fundamental problem of it is to determine the efflux of a vein of water or any other fluid issuing from an aperture made in the sides or bottom of a vessel kept constantly full, or allowed to empty itself. Torricelli had demonstrated that, abstracting the resistances, the velocities of fluids issuing from very small orifices followed the subduplicate ratio of the pressures. This law had been, in a measure, confused by subsequent writers, in consequence of the discrepancies which appeared to exist between the theory and experiment, until Varignon remarked, that when water escaped from a small opening made in the bottom of a cylindrical vessel, there appeared to be very little, or scarcely any, sensible motion in the particles of the water; from which he concluded that the law of acceleration existed, and that the particles which escaped at every instant of time received their motion simply from the pressure produced by the weight of the fluid column above the orifice; and that the quantity of motion or expenditure is in the ratio of the breadth of the orifice, multiplied by the square of the velocity, or in other words, that the height of the water in the vessel is proportional to the square of the velocity with which it escapes; which is precisely the theorem of Torricelli. This mode of reasoning is in some degree vague, because it supposes that the small mass which escapes from the vessel at each instant of time acquires its velocity from the pressure of the column immediately above the orifice. But supposing, as is natural, that the weight of the column

acts on the particle during the time it takes to issue from the vessel, it is clear that this particle will receive an accelerated motion, whose quantity in a given time will be proportional to the pressure multiplied by the time: hence the product of the weight of the column by the time of its issuing from the orifice, will be equal to the product of the mass of this particle by the velocity it will have acquired; and as the mass is the product of the opening of the orifice, by the small space which the particle describes in issuing from the orifice, it follows that the height of the column will be as the square of the velocity acquired. This theory is the more correct the more the fluid approaches to a perfect state of repose, and the more the dimensions of the vessel exceed the dimensions of the orifice. By a contrary mode of reasoning, this theory became insufficient to determine the motions of fluids through pipes of small diameters. It is necessary, therefore, to consider all the motions of the particles of fluids, and examine how they are changed and altered by the figure of the conduit. But experiment teaches us that when a pipe has a different direction from the vertical one, the different horizontal sections of the fluid preserve their parallelism, the sections following taking the place of the preceding ones; and so on; from which it follows (on account of the [sensible] incompressibility of the fluid) that the velocity of each horizontal section or plate, taken vertically, ought to be in the inverse ratio of the diameter of the section. It suffices, therefore, to determine the motion of a single section, and the problem then becomes analogous to the vibration of a compound pendulum, by which, according to the theory of James Bernoulli, the motions acquired and lost at each instant of time form an equilibrium, as may be supposed to take place with the different sections of a fluid in a pipe, each section being animated with velocites acquired and lost at every instant of time.

The theory of Bernoulli had not been proposed by him until long after the discovery of the indirect principle of *vis viva* by Huygens. The same was the case with the problem of the motions of fluids issuing from vessels, and it is surprising that no advantage had been taken of it earlier. Michelloti, in his experimental researches, *de Separatione Fluidorum in Corpore Animali*, in rejecting the theory of the Newtonian cataract, (which had been advanced in Newton's *Mathematical Principles*, in the year 1687; but afterwards corrected in the year 1714,) supposes the water to escape from an orifice in the bottom of a vessel kept constantly full, with a velocity produced by the height of the superior surface; and that if, immediately above the lowest plate of water escaping from the orifice, the column of water be frozen, the weight of the column will have no effect on the velocity of the water issuing from the orifice; and that if this solid column be at once changed to its liquid state, the effect will remain the same.

The Marquis Poleni, in his work *De Castellis per quæ derivantur Fluviorum Aquæ*, published at Padua in the year 1718, shows from many experiments, that if A be the orifice, and H the height of the column above it, the quantity of water which issues in a given time is represented by $2\ A\ H \times \frac{0 \cdot 571}{1 \cdot 000}$, whereas if it spouted out from the orifice with a velocity acquired by falling from the height H, it ought to be exactly 2 A H, so that experiment only gives a little more than half the quantity promised by the theory; hence, if we were to calculate from these experiments the velocity that the water ought to have to furnish the necessary quantity, we should find that it would hardly make it re-ascend one-third of its height. These experiments would have been quite contrary to expectation, had not Sir Isaac Newton observed that water issuing from an orifice $\frac{5}{8}$ths of an inch in diameter was contracted $\frac{21}{25}$ of the diameter of the orifice, so that the cylinder of water which actually issued was less than it ought to have been, according to the theory, in the ratio of 441 to 625; and augmenting it in this proportion, the opening should have been $2\ A\ H \frac{0 \cdot 805}{1 \cdot 000}$, or $\frac{4}{5}$ths of the quantity which ought to have issued on the supposition that the velocity was in the ratio of the square root of the height; from which it was inferred that the theory was correct, but that the discrepancy was owing to certain resistances, which experiment could alone determine. The accuracy of the general conclusion was affected by several assumptions, namely, the perfect fluidity and sensibility of the mass, which was neither affected by friction nor cohesion, and an infinitely small thickness in the edge of the aperture.

Daniel Bernoulli, in his great work, *Hydrodynamica, seu de Viribus et Motibus Fluidorum Commentaria*, published at Strasburg in the year 1738, in considering the efflux of water from an orifice in the bottom of a vessel, conceives the fluid to be divided into an infinite number of horizontal strata, on the following suppositions, namely, that the upper surface of the fluid always preserves its horizontality; that the fluid forms a continuous mass; that the velocities vary by insensible gradations, like those of heavy bodies; and that every point of the same stratum descends vertically with the same velocity, which is inversely proportional to the area of the base of the stratum; that all sections thus retaining their parallelism are contiguous, and change their velocities imperceptibly; and that there is always an equality between the vertical descent and ascent, or *vis viva:* hence he arrives, by a very simple and elegant process, to the equations of the problem, and applies its general formulæ to several cases of practical utility.

When the figure of the vessel is not subject to the law of continuity, or when sudden and finite changes take place in the velocities of the sections, there is a loss of *vis viva*, and the equations require to be modified. John Bernoulli and Maclaurin arrived at the same conclusions by different steps, somewhat analogous to the cataract of Newton. The investigations of D'Alembert had been directed principally to the dynamics of solid bodies, until it occurred to him to apply them to fluids; but in following the steps of Bernoulli he discovered a formula applicable to the motions of fluid and reducible to the ordinary laws of hydrostatics. The application of his theory to elastic and non-elastic bodies, and the determination of the motions of fluids in flexible pipes, together with his investigations relative to the resistance of pipes, place him high in the ranks of those who have contributed to the perfection of the science.

The celebrated Euler, to whom every branch of science owes such deep obligations, seems to have paid particular attention to the subject of hydrodynamics; and in attempting to reduce the whole of it to uniform and general formulæ, he exhibited a beautiful example of the application of analytical investigation to the solution of a great variety of problems for which he was so famous. The *Memoirs of the Academy of Berlin*, from the year 1768 to 1771, contain numerous papers relative to fluids flowing from orifices in vessels, and through pipes of constant or variable diameters. "But it is greatly to be regretted," says M. Prony, "that Euler had not treated of friction and cohesion, as his theory of the linear motion of air would have applied to the motions of fluids through pipes and conduits, had he not always reasoned on the hypothesis of mathematical fluidity independently of the resistances which modify it."

In the year 1765 a very complete work was published at Milan by Paul Lecchi, a celebrated Milanese engineer, entitled *Idrostatica esaminata ne' suoi Principi e Stabilite nelle suoi Regole della Mensura della Acque correnti*, containing a complete examination of all the different theories which had been proposed to explain the phænomena of effluent water, and the doctrine of the resistance of fluids. The author treats of the velocity and quantity of water, whether absolutely or relatively, which issues from orifices in vessels and reservoirs, according to their different altitudes, and inquires how far the law applies to masses of water flowing in canals and rivers, the velocities and quantities of which he gives the methods of measuring. The *extensive and successful practice* of Lecchi as an engineer added much to the reputation of his work.*

In the year 1764, Professor Michelotti, of Turin, undertook, at the

* See also *Memorie Idrostatico-storiche*, 1773.

expense of the King of Sardinia, a very extensive series of experiments on running water, issuing orifices, and additional tubes placed at different heights in a tower of the finest masonry, twenty feet in height and three feet square inside. The water was supplied by a channel two feet in width, and under pressures of from five to twenty-two feet. The effluent waters were conveyed into a reservoir of ample area, by canals of brick-work lined with stucco, and having various forms and declivities; and the experiments, particularly on the efflux of water through differently shaped orifices, and additional tubes of different lengths, were most numerous and accurate, and Michelotti was the first who gave representations of the changes which take place in the figure of the fluid vein, after it has issued from the orifice. His experiments on the velocities of rivers, by means of the bent tube of Pitot, and by an instrument resembling a water-wheel, called the *stadera idraulica*, are numerous and interesting; but, unfortunately, their reduction is complicated with such various circumstances, that it is difficult to derive from them any satisfactory conclusions. But Michelotti is justly entitled to the merit of having made the greatest revolution in the science by experimental investigation.* The example of Michelotti gave a fresh stimulus to the exertions of the French philosophers, to whom, after the Italians, the science owes the greatest obligations. Accordingly, the Abbé Bossut, a most zealous and enlightened cultivator of hydrodynamics, undertook, at the expense of the French government, a most extensive and accurate series of experiments, which he published in the year 1771, and a more enlarged edition, in two volumes, in the year 1786, entitled *Traité Théorique et Expérimental d' Hydrodynamique.* The first volume treats of the general principles of hydrostatics and hydraulics, including the pressure and equilibrium of non-elastic and elastic fluids against inflexible and flexible vessels; the thickness of pipes to resist the pressure of stagnant fluids; the rise of water in barometers and pumps, and the pressure and equilibrium of floating bodies; the general principles of the motions of fluids through orifices of different shapes, and their friction and resistance against the orifices; the oscillations of water in syphons; the percussion and resistance of fluids against solids; and machines moved by the action and re-action of water. The second volume gives a great variety of experiments on the motions of water through orifices and pipes and fountains; their resistance in rectangular or curvilinear channels, and against solids moving through them; and, lastly, of the fire—or steam-engine. In the course of these experiments, he found that when the water flowed through an orifice in a thin plate, the con-

* *Sperimenti Idraulici*, 1767 and 1771.

traction of the fluid vein diminished the discharge in the ratio of 16 to 10; and when the fluid was discharged through an additional tube, two or three inches in length, the theoretical discharge was diminished only in the ratio of 16 to 13. In examining the effects of friction, Bossut found that small orifices discharged less water in proportion than large ones, on account of friction, and that, as the height of the reservoir augmented, the fluid vein contracted likewise; and by combining these two circumstances together, he has furnished the means of measuring with precision the quantity of water discharged either from simple orifices or additional tubes, whether the vessels be constantly full, or be allowed to empty themselves. He endeavoured to point out the law by which the diminution of expenditure takes place, according to the increase in the length of the pipe or the number of its bends; he examined the effect of friction in diminishing the velocity of a stream in rectangular and curvilinear channels; and shewed that in an open canal, with the same height of reservoir, the same quantity of water is always discharged, whatever be the declivity and length; that the velocities of the waters in the canal are not as the square roots of the declivities, and that in equal declivities and depth of the canal the velocities are not exactly as the quantities of water discharged; and he considers the variations which take place in the velocity and level of the waters, when two rivers unite, and the manner in which they establish their beds.

His experiments in conjunction with D'Alembert and Condorcet, on the resistance of fluids, in the year 1777, and his subsequent application of them to all kinds of surfaces, including the shock and resistance of water wheels, have justly entitled him to the gratitude of posterity. The Abbé Bossut had opened out a new career of experiments; but the most difficult and important problem remaining to be solved related to rivers. It was easy to perform experiments with water running through pipes and conduits on a small scale, under given and determined circumstances: but when the mass or fluid rolled in channels of unequal capacities, and which were composed of every kind of material, from the rocks amongst which it accumulated to the gravel and sand through which it forces a passage,—at first a rapid and impetuous torrent, but latterly holding a calm and majestic course,—sometimes forming sand-banks and islands, at other times destroying them, at all times capricious, and subject to variation in its force and direction by the slightest obstacles,—it appeared impossible to submit them to any general law.

Unappalled, however, by these difficulties, the Chevalier Buat, after perusing attentively M. Bossut's work, undertook to solve them by means of a theorem which appeared to him to be the key of the whole science of hydraulics. He considered that if water was in a perfect

state of fluidity, and ran in a bed from which it experienced no resistance whatever, its motion would be constantly accelerated, like the motion of a heavy body descending an inclined plane; but as the velocity of a river is not accelerated *ad infinitum*, but arrives at a state of uniformity, it follows that there exists some obstacle which destroys the accelerating force, and prevents it from impressing upon the water a new degree of velocity. This obstacle must therefore be owing either to the viscidity of the water, or to the resistance it experiences against the bed of the river; from which Dubuat derives the following principle:—That when water runs uniformly in any channel, the accelerating force which obliges it to run is equal to the sum of all the resistances which it experiences, whether arising from the viscidity of the water or the friction of its beds. Encouraged by this discovery, and by the application of its principles to the solution of a great many cases in practice, Dubuat was convinced that the motion of water in a conduit pipe was analogous to the uniform motion of a river, since in both cases gravity was the cause of motion, and the resistance of the channel or perimeter of the pipes the modifiers. He then availed himself of the experiments of Bossut on conduit pipes and artificial channels to explain his theory: the results of which investigations were published in the year 1779. M. Dubuat was, however, sensible that a theory of so much novelty, and at variance with the then received theory, required to be supported by experiments more numerous and direct than those formerly undertaken, as he was constrained to suppose that the friction of the water did not depend upon the pressure, but on the surface and square of the velocity. Accordingly, he devoted three years to making fresh experiments, and, with ample funds and assistance provided by the French government, was enabled to publish his great work, entitled *Principes d' Hydraulique vérifiés par un grand nombre d' Experiences, faites par Ordre du Governement*, 2 vols. 1786, (a third volume, entitled *Principes d' Hydraulique et Hydrodynamique*, appeared in 1816;)—in the first instance, by repeating and enlarging the scale of Bossut's experiments on pipes (with water running in them) of different inclinations or angles, of from 90° to $\frac{1}{40000}$th part of a right angle, and in channels of from 1½ line in diameter to 7 and 8 square toises of surface, and subsequently to water running in open channels, in which he experienced great difficulties in rendering the motion uniform: but he was amply recompensed by the results he obtained on the diminution of the velocity of the different parts of a uniform current, and of the relation of the velocities at the surface and bottom, by which the water works its own channel, and by the knowledge of the resistances which different kinds of beds produce, such as clay, sand, and gravel; and varying the experiments on the effect of sluices, and the piers of

bridges, &c., he was enabled to obtain a formula applicable to most cases in practice.*

Thus let V = mean velocity per second, in inches.

d = hydraulic mean depth, or quotient which arises from dividing the area or section of the canal, in square inches, by the perimeter of the part in contact with the water, in linear inches.

s = the slope or declivity of the pipe, or the surface of the water.

g = 16·087, the velocity in inches which a body acquires in falling one second of time.

n = an abstract number, which was found by experiment to be equal to 243·7.

$$\text{then } v = \frac{\sqrt{n g}\,(\sqrt{d - 0\cdot 1})}{\sqrt{s} - \log.\sqrt{s} + 1\cdot 6} - 0\cdot 3\,(\sqrt{d} - 0\cdot 1).$$

Such are some of the objects of M. Dubuat's work. But his hypotheses are unfortunately founded upon assumptions which render the applications of his theory of little use. It is evident that the supposition of a constant and uniform velocity in rivers cannot hold: nevertheless he has rendered great services to the science by the solution of many important questions relating to it; and although he has left on some points a vast field open to research, he is justly entitled to the merit of originality and accuracy.

Contemporary with Dubuat was M. Chezy, one of the most skilful engineers of his time: he was director of the Ecole des Ponts et Chaussées, and reported, conjointly with M. Perronet, on the Canal Yvette. He endeavoured to assign, by experiment, the relation existing between the inclination, length, transverse section, and velocity of a canal. In the course of this investigation he obtained a very simple expression of the velocity, involving three different variable quantities, and capable, by means of a single experiment, of being applied to all currents whatever. He assimilates the resistance of the sides and bottom of the canal to known resistances, which follow the law of the square of the velocity, and he obtains the following simple formula:

$v = \dfrac{\sqrt{g d}}{z s}$, where g is $= 16\cdot 087$ feet, the velocity acquired by a heavy body after falling one second.

$d =$ hydraulic mean depth, equal to the area of the section divided by the perimeter of the part of the canal in contact with the water.

* *Edinburgh Encyclopaedia*, Art. Hydrodynamics, by Brewster.

s = the slope or declivity of the pipe.
z = an abstract number, to be determined by experiment.

In the year 1784, M. Lespinasse published in the *Memoirs of the Academy of Sciences at Toulouse* two papers, containing some interesting observations on the expenditure of water through large orifices, and on the junction and separation of rivers. The author had performed the experiments contained in his last paper on the rivers Fresquel and Aude, and on that part of the canal of Languedoc below the Fresquel lock, towards its junction with that river.

As we before stated, M. Dubuat had classified with much sagacity his observations on the different kinds of resistance experienced in the motion of fluids, and which might have led him to express the sum of the resistances by a rational function of the velocity composed of two or three terms only. Yet the merit of this determination was reserved to M. Coulomb, who, in a beautiful paper, entitled "Expériences destinées à déterminer la Cohérence des Fluides et les Lois de leurs Résistances dans les Mouvemens très lents," proves, by reasoning and facts,

1st. That in extremely slow motions the part of the resistance is proportional to the square of the velocity.

2ndly. That the resistance is not sensibly increased by increasing the height of the fluid above the resisting body.

3rdly. That the resistance arises solely from the mutual cohesion of the fluid particles, and not from their adhesion to the body upon which they act.

4thly. That the resistance in clarified oil, at the temperature of 69° Farenheit, is to that of water as 17·5 : 1; a proportion which expresses the ratio of the mutual cohesion of the particles of oil to the mutual cohesion of the particles of water.

M. Coulomb concludes his experiments by ascertaining the resistance experienced by cylinders that move very slowly and perpendicularly to their axes, &c.

This eminent philosopher, who had applied the doctrine of tension with such distinguished success in investigating the phænomena of electricity and magnetism, entertained the idea of examining in a similar manner the resistance of fluids, contrary to the doctrines of resistance previously laid down. M. Coulomb proved, that in the resistance of fluids against solids, there was no constant quantity of sufficient magnitude to be detected; and that the pressure sustained by a moving body is represented by two terms, one which varies as the simple velocity, and the other with its square.

The apparatus with which these results were obtained consisted of discs of various sizes, which were fixed to the lower extremity of a

brass wire, and were made to oscillate under a fluid by the force of tension of the wire. By observing the successive diminution of the oscillations, the law of resistance was easily found. The oscillations which were best suited to these experiments continued for twenty or thirty seconds, and the amplitude of the oscillation (that gave the most regular results) was between 480 the entire division of the disc, and 8 or 10 divisions from zero.

The first who had the happy idea of applying the law of Coulomb to the case of the velocities of water running in natural or artificial channels was M. Girard, Ingénieur en chef des Ponts et Chaussées, and Director of the Works of the Canal l' Ourcq at Paris.*

He is the author of several papers on the theory of running waters, and of a valuable series of experiments on the motions of fluids in capillary tubes.

M. Coulomb had given a common co-efficient to the two terms of his formula, representing the resistance of a fluid,—one proportional to the simple velocity, the other to the square of the velocity. M. Girard found that this identity of the co-efficients was applicable only to particular fluids under certain circumstances; and his conclusions were confirmed by the researches of M. Prony, derived from a great many experiments, which make the co-efficients not only different, but very inferior to the value of the motion of the filaments of the water contiguous to the side of the pipe.

The object of M. Girard's experiments was to determine this velocity; and this he has effected in a very satisfactory manner, by means of twelve hundred experiments, performed with a series of copper tubes, from 1·83 to 2·96 millimetres in diameter, aud from 20 to 222 centimetres in length; from which it appeared, that when the velocity was expressed by 10, and the temperature was 0, centigrade, the velocity was increased four times when the temperature amounted to 85°. When the length of the capillary tube was below that limit, a variation of temperature exercised very little influence upon the velocity of the issuing fluid, &c.

It was in this state of the science that M. Prony (then having under his direction different projects for canals) undertook to reduce the solution of many important problems on running water to the most strict and rigorous principles, at the same time capable of being applied with facility to practice.

For this purpose he selected fifty-one experiments which corresponded best on conduit pipes, and thirty-one on open conduits. Proceeding, therefore, on M. Girard's theory of the analogy between

* *Essai sur le Mouvement des Eaux courantes: Paris,* 1804. *Récherchés sur les Eaux publiques, &c. Devis général du Canal l' Ourcq, &c.*

fluids and a system of corpuscular solids or material bodies, gravitating in a curvilinear channel of indefinite length, and occupying and abandoning successively the different parts of the length of channel, he was enabled to express the velocity of the water, whether it flows in pipes or in open conduits, by a simple formula, free of logarithms, and requiring merely the extraction of the square root.*

Thus $v = -0{\cdot}0469734 + \sqrt{0{\cdot}0022065 + 3041{\cdot}47 \times G}$, which gives the velocity in metres: or, in English feet,

$$v = -0{\cdot}1541131 + \sqrt{0{\cdot}023751 + 32806{\cdot}6 \times G}.$$

When this formula is applied to pipes, we must take $G = \frac{1}{4} D K$, which is deduced from the equation $K = \frac{H + Z = H}{L}$. When it is applied to canals, we must take $G = R I$, which is deduced from the equation $I = \frac{Z}{L}$, K being equal to the mean radius of Dubuat on the hydraulic mean depth, and I equal to the sine of inclination in the pipe or canal. M. Prony has drawn up extensive tables, in which he has compared the observed velocities with those which are calculated from the preceding formulæ, and from those of Dubuat and Girard. In both cases the coincidence of the observed results with the formulæ is very remarkable, but particularly with the formulæ of M. Prony But the great work of M. Prony is his *Nouvelle Architecture Hydraulique*, published in the year 1790. This able production is divided into five sections, viz, Statics, Dynamics, Hydrostatics, Hydrodynamics, and on the physical circumstances that influence the motions of machines. The chapter on hydrodynamics is particularly copious and explanatory of the motions of compressible and incompressible fluids in pipes and vessels, on the principle of the parallelism of the fluid filaments, and the efflux of water through different kinds of orifices made in vessels kept constantly full or permitted to empty themselves; he details the theory of the clepsydra, and the curves described by spouting fluids; and having noticed the different phænomena of the contraction of the fluid vein, and given an account of the experiments of Bossut, M. Prony deduces formulæ by which the results may be expressed with all the accuracy required in practice.

In treating of the impulse and resistance of fluids, M. Prony explains the theory of Don George Juan, which he finds conformable to the experiments of Smeaton, but to differ very materially from the previously received law of the product of the surfaces by the squares of the velocities, as established by the joint experiments of D'Alembert, Condorcet, and Bossut, in the year 1775. The concluding part of the fourth section is devoted to an examination of the theory of the equi-

* *Memoires des Savans Etrangers, &c.* 1815.

librium and motion of fluids according to Euler and D'Alembert; and by a rigorous investigation of the nature of the questions to be determined, the whole theory is reduced to two equations only, in narrow pipes, according to the theory of Euler, showing its approximation to the hypothesis of the parallelism of filaments.

The fifth and last section investigates the different circumstances, such as friction, adhesion, and rigidity, which influence the motions of machines.

A second volume, published in the year 1796, is devoted to the theory and practice of the steam-engine. Previously to the memoir of M. Prony, *Sur le Jaugeage des Eaux courantes*, in the year 1802, no attempt had been made to establish with certainty the correction to be applied to the theoretical expenditures of fluids through orifices and additional tubes. The phænomenon had been long noticed by Sir Isaac Newton, and illustrated by Michelotti by a magnificent series of experiments, which, although involving some intricacies, have certainly formed the ground-work of all the subsequent experiments upon this particular subject.

By the method of interpolation, M. Prony has succeeded in discovering a series of formulæ applicable to the expenditures of currents out of vertical and horizontal orifices, and to the contraction of the fluid vein; and in a subsequent work, entitled *Recherches sur le Mouvemens des Eaux courantes*, he establishes the following formulæ for the mean velocities of rivers.

When $V =$ velocity at the surface,
and $U =$ mean velocity,
$U = 0{\cdot}816458\ V$,
which is about $\frac{4}{5}$ V.

These velocities are determined by two methods, 1st. By a small water-wheel for the velocity at the surface, and the improved tube of Pitot for the velocities at different depths below the surface.

If $h =$ the height of the water in the vertical tube above the level of the current, the velocity due to this height will be determined by the formulæ $V = \sqrt{2\,g\,h} = \sqrt{\overset{\text{metres}}{19{\cdot}606}\,h} = 4{\cdot}429\sqrt{h}$.

When water runs in channels, the inclination usually given amounts to between $\frac{1}{300}$th part of the length, which will give a velocity of nearly $1\frac{1}{4}$ mile per hour, sufficient to allow the water to run freely in earth. We have seen the inclination very conveniently applied in cases of drainage at $\frac{1}{1200}$th and $\frac{1}{1300}$th, and some rivers are said to have $\frac{1}{3000}$th only.

M. Prony gives the following formulæ from a great number of observations:

If U = mean velocity of the water in the canal,
I = the inclination of the canal per metre,
R = the relation of the area to the profile of its perimeter, we shall have

$$U = -0 \cdot 07 + \sqrt{0 \cdot 005 + 3233.\ R.\ I};$$

and for conduit pipes,
calling U = the mean velocity,
Z = the head of water in the inferior orifice of the pipe,
L = the length of the pipe in metres,
D = the diameter of the pipe,
we shall have

$$U = -0 \cdot 0248829 + \sqrt{0 \cdot 000619159 + 717 \cdot 857 \frac{D Z}{L}}$$

or, where the velocity is small,

$$U = 26 \cdot 79 \sqrt{\frac{D Z}{L}}$$

that is, the mean velocities approximate to a direct ratio compounded of the squares of the diameters and heads of water, and inversely as the square root of the length of the pipes: and by experiments made with great care, M. Prony has found that the formula

$$U = -0 \cdot 0248829 + \sqrt{0 \cdot 000619159 + 717 \cdot 857 \frac{D Z}{L}}$$

scarcely differs more or less from experiments than $\frac{1}{40}$ or $\frac{1}{25}$. The preceding formulæ suppose that the horizontal sections, both of the reservoir and the recipient, are great in relation to the transverse section of the pipe, and that the pipe is kept constantly full.*

In comparing the formulæ given for open and close canals, M. Prony has remarked that these formulæ are not only similar, but the constants which enter into their composition are nearly the same, so that either of them may represent the two series of phænomena with sufficient exactness.

The following formula applies equally to open or close canals:

* According to Mr. Jardine's experiments on the quantity of water delivered by the Coniston Main, from Coniston to Edinburgh, the following is a comparison:

	Scots Pints.
Actual delivery of Coniston Main	189·4
Ditto by Eytelwein's formula	189·77
Ditto by Girard's formula	189·26
Ditto by Dubuat's formula	188·13
Ditto by Prony's simple formula	192·32
Ditto by Prony's tables	180·7

$$U = -0{\cdot}0468734 + \surd\left(0{\cdot}0022065 + 3041{\cdot}47\,\frac{D\,Z}{L}\right)$$

But the most useful of the numerous formulæ given by M. Prony for open canals is the following:

Let tg = the velocity of a body falling in one second,
w = the area of the transverse section,
p = the perimeter of that section,
I = the inclination of the canal,
Q = the constant volume of water through the section,
U = the mean velocity of the water,
R = the relation of the area to the perimeter of the section,

then 1st. $0{\cdot}000436\ U + 0{\cdot}003034\ U^2 = g\,I\,R = g\,I\,\frac{w}{p}$;

2ndly. $U = \frac{Q}{w}$;

3rdly. $R\,w^2 - 0{\cdot}000444499\ .\ w\,\frac{Q}{I} - 0{\cdot}000309314\,\frac{Q^2}{I} = O.$

This last equation, containing the quantities

$$Q\ I\ w \text{ and } R = \frac{w}{p},$$

shews how to determine one of them, and, knowing the three others, we shall have the following equations:

4thly. $p = \dfrac{g\,I\,w^2}{0{\cdot}000436\ Q\,w + 0{\cdot}003034\ Q^2}$

5thly, $I = \underline{p\ (0{\cdot}0000444499\ Q\,w + 0{\cdot}000309314\ Q^2).}$

6thly. $w = 0{\cdot}000436 \pm \dfrac{\surd[(0{\cdot}000436)^2 + 4(0{\cdot}003034)\,g\,R\,I]\ Q}{2g\,R\,I}$

These formulæ are, however, modified in rivers by circumstances, such as weeds, vessels, and other obstacles in the rivers; in which case M. Girard has conceived it necessary to introduce into the formulæ the co-efficient of correction $= 1{\cdot}7$ as a multiplier of the perimeter, by which the equations will be,

$p - 1{\cdot}7\ (0{\cdot}000436\ U + 0{\cdot}003034\ U^2) = g\ I\ w.$

The preceding are among the principal researches of this distinguished philosopher.*

In the year 1798, Professor Venturi of Modena published a very interesting memoir, entitled *Sur la Communication laterale du Movement des Fluides.* Sir Isaac Newton was well acquainted with this communication, having deduced from it the propagation of rotary motion from the interior to the exterior of a whirlpool; and had affirmed that when motion is propagated in a fluid, and has passed

* *Recherches Physico-Mathematiques sur la Théorie des Eaux courantes, par M. Prony.*

beyond the aperture, the motion diverges from that opening, as from a centre, and is propagated in right lines towards the lateral parts. The simple and immediate application of this theorem cannot be made to a jet or aperture at the surface of still water. Circumstances enter into this case which transform the results of the principal into particular motions. It is nevertheless true that the jet communicates its motion to the lateral parts without the orifice, but does not repel it in a radial divergency. M. Venturi illustrates his theory by experiments on the form and expenditure of fluid veins issuing from orifices, and shows how the velocity and expenditure are increased by the application of additional tubes; and that in descending cylindrical tubes, the upper ends of which possess the form of the contracted vein, the expense is such as corresponds with the height of the fluid above the inferior extremity of the tube. The ancients remarked that a descending tube applied to a reservoir increased the expenditure.* D'Alembert, Euler and Bernoulli attributed it to the pressure of the atmosphere. Gravesend, Guglielmini, and others sought for the cause of this augmentation in the weight of the atmosphere, and determined the velocity at the bottom of the tube to be the same as would arise from the whole height of the column, including the height of the reservoir. Guglielmini supposed that the pressure at the orifice below is the same for a state of motion as for that of rest, which is not true. In the experiments he made for that purpose, he paid no regard either to the diminution of expenditure produced by the irregularity of the inner surface of the tubes, or the augmentation occasioned by the form of the tubes themselves. But Venturi established the proposition upon the principle of vertical ascension combined with the pressure of the atmosphere, as follows:

1st. That in additional conical tubes the pressure of the atmosphere increases the expenditure in the proportion of the exterior section of the tube to the section of the contracted vein, whatever be the position of the tube.

2dly. That in cylindrical pipes the expenditure is less than through conical pipes, which diverge from the contracted vein, and have the same exterior diameter. This is illustrated by experiments with differently formed tubes, as compared with a plate orifice and a cylindrical tube, by which the ratios in point of time were found to 41″, 31″ and 27″, showing the advantage of the conical tube.

3rdly. That the expenditure may be still further increased, in the ratio of twenty-four to ten, by a certain form of tube,—a circumstance of which he supposes the Romans were well aware, as appears

* "Calix devexus amplius rapit."—*Frontinus de Aqueductibus*. See also the *Pneumatics* of Hero.

from their restricting the length of the pipes of conveyance from the public reservoirs to fifty feet; but it was not perceived that the law might be equally evaded by applying a conical frustum to the extremity of the tube.

M. Venturi then examines the causes of eddies in rivers; whence he deduces from his experiments on tubes with enlarged parts, that every eddy destroys part of the moving force of the current of the river, of which the course is permanent and the sections of the bed unequal; that the water continues more elevated than it would have done if the whole river had been equally contracted to the dimensions of its smallest section, a consequence extremely important in the theory of rivers, as the retardation experienced by the water in rivers is not only due to the friction over the bed, but to eddies produced from the irregularities in the bed, and the flexures or windings of its course: a part of the current is thus employed to restore an equilibrium of motion, which the current itself continually deranges. As respects the contracted vein, it had been pretended by the Marquis de Lorgna* that the contracted vein was nothing else but a continuation of the Newtonian cataract, and that the celerity of the fluid issuing from an orifice in a thin plate, is much less than that of a body which falls from the height of the charge. But Venturi proved that the contraction of the vein is incomparably greater than can be produced by the acceleration of gravity, even in descending streams, the contraction of the stream being 0·64, and the velocity nearly the same as that of a heavy body which may have fallen through the height of the charge. These experimental principles, which are in accordance with the results of Bossut, Michelotti, and Poleni, are strictly true in all cases where the orifice is small in proportion to the section of the reservoir, and when that orifice is made in a thin plate, and the internal afflux of the filaments is made in uniform manner round the orifice itself.

Venturi then shows the form and contraction of the fluid vein, by increased charges. His experiments with the cone are curious; it would have been greatly to be regretted that he had stopped short in his investigations, but for the more extensive reseaches of Bidone and Lesbros. M. Hachette, in opposition to the theory of Venturi, assigns, as a cause of the increase by additional tubes, the adhesion of the fluid to the sides of the tubes arising from capillary attraction.

* *Memorie della Società Italiana*, vol. iv.

[*To be continued.*]

CRITICAL NOTICES AND REVIEWS.

An Essay on the Nature and Application of Steam, with an Historical Notice of the Rise and Progressive Improvement of the Steam-Engine. By M. A. ALDERSON. London: Sherwood, Gilbert, & Piper, 1834.

THE work before us is an Essay, rewarded by the managers of the London Mechanics' Institution. In noticing this production, we will principally call attention to the panegyric passed on the manuscript by Dr. Lardner, who, in adjudging the prize, is stated to have addressed the audience in the following terms: "He had the pleasure of examining them (the five manuscript Essays), and he could safely say, from a pretty extensive experience in examining manuscripts from persons of the highest pretensions, that the very worst of them (the Essays) exceeded the ordinary standard, even in purely literary qualities. Each of them contained a clear and satisfactory account of the nature of steam-engines, written with surprising ease and facility, collecting together all the facts, and arranging them in clear, distinct, and well-selected language. The ground of preference was not only the superiority of the materials, but its being, as a whole, more clear, and written in a better literary style, with superior drawings." A work coming out under the auspicious aid of such flattering encomiums, might naturally be expected to contain something not ordinarily met with,—qualities of rare occurrence; but what will be the surprize of our readers, to find that the work does not even approach mediocrity, wanting in correctness of information, omitting many of the most material facts, written in the most flippant style, displaying just that much knowledge which gives to its possessor the highest possible opinion of himself, but stopping short of that stage which would have convinced him, how little man can know. We do

not blame the author, who, we presume, in order to stand the trial for the prize, must have had the advantages offered by the schools of the Mechanics' Institute; but, judging from the unjustness of the praise given to the production now before us, by one of the managers of tha tinstitution, we may, without hesitation, say there is a rottenness, a want of principle, in the system pursued in that establishment, which cannot by possibility produce that knowledge which it is well for man to know. We have ever been advocates for extending the advantages of education to all classes, but we are advocates only when that education is tempered with morality, which, in strengthening the mind, adds vigour to its conception. It is not the surface knowledge of the properties of steam, of chemistry, or of any other department of the sciences which improves the condition of man; but, on the contrary, such instruction tends only to weaken his natural capabilities, when unsupported by the more solid foundation of morality. "Mere intellectual education cannot improve the moral condition of the labouring classes; it cannot render them better men or better citizens; but it can teach them their own power; and it is doing so at a period when that tuition is pregnant with danger to themselves*;" yet this is the description of education which evidently has been the means of producing the work now under consideration. We can scarcely believe that Dr. Lardner ever could have used such words as those quoted, intending them to apply to this Essay; yet we have not heard that he has taken any opportunity of denying them. The doctor is too well informed not to know the pernicious effects of undeserved praise coming from a superior, and that superior one of the heads of an institution intended for instruction. Individuals so placed are bound, if conscience, if honour guide them, to advise with sincerity and truth those partially educated minds over whom they

* Gaskell on the Manufacturing Population of England.

have influence. We can readily believe that this Essay, merely taking into consideration the opportunities the author has had of obtaining information, may justly have entitled him to the reward in preference to his competitors; but to be told that this production exceeded the standard of authors of the highest pretensions, is a wantonness of flattery that will neither advance the character of the work nor of the individual who is willing to obtain popularity by such means. Under ordinary circumstances, we should have thought it our duty to place this work on the shelf, at the same time, probably, expressing our regret that the writer had not had the advantage of a sincere friend, who, being capable of judging of the value of the production, might have advised him, that although from the extent of the capabilities of his competitors, and the opportunities he and they had had of obtaining information on the subject in question, the prize had been awarded to him, the work was no more deserving publication than the prize themes of a school boy. We will give a few extracts, taken from the first six pages, that our readers may judge of the "purely literary qualities" of the work, but more particularly of the clear views the writer must have of the nature of steam. We commence with the invention of the steam-generator, which we find thus stated: "Whoever was the first to *submit steam* to the action of fire in a close vessel, may be termed the inventor of the steam-generator or boiler" (page 3). We presume he meant to say, "was the first to *submit water*," but this is one of the proofs of the correct and well-selected language which Dr. Lardner eulogizes. In the same page we are told that "steam, when raised in open vessels, *is powerless* as smoke, and rises plentifully from water exposed to the action of fire in such vessel, when it reaches that degree of temperature indicated by 212 degrees of Fahrenheit's thermometer;" and yet, (at page 6,) we are informed, "At the pressure of the atmosphere

steam occupies a space eighteen hundred times greater than in the form of water, and yet continues equal in *its expansive power* to the atmospheric pressure;" and that "Steam at 212° will sustain a column of mercury 30 inches in height." We are aware what the writer would have said; but we cannot agree that it is "clear, distinct, and well-selected language," to say that steam is powerless because it is not resisted. We will give one instance of the elegance of the author's style; in speaking of the decomposition of water by passing it through a red hot iron tube, he observes, "by carrying this principle to a great extreme, several modern inventions have approximated so near to the foregoing experiment as to end in a similar result; for instead of generating steam, they decomposed the 'stuff' of which it is made." We imagine there must be some intended wit in this word stuff, by its being placed between inverted commas; but we leave it to our readers to ascertain its point, for we confess we cannot. We may here remark, that there is at least one peculiarity in the work, there being a great proneness thus to place words, such as "stuff," "vapours," "prime-mover," "modern," "practical," "powerful," between notes of quotation; there is scarcely a page that has not single and compound words thus marked,— for what reason, we will not presume to venture an opinion. To enter further into detail with such a production, would be a waste of time to our readers and to ourselves.

The Use of Machinery in the Erection of Buildings and Scaffolding, &c. &c. By ROBERT PIRIE. London, Whittaker and Co., 1834.

IN writing a work on any subject, particularly a mechanical one, there are two requisites to constitute an author; the first above all is a perfect knowledge of the

subject to be treated of; next, a capability of conveying, by written description, that knowledge to others. Now the first may be possessed by an individual without any pretensions to the next requisite; and a book written under such circumstances must unquestionably fail.

We have been induced to make these remarks from feeling the case above drawn most strikingly illustrative of the work before us. Mr. Pirie may be very clever in arranging the means necessary for carrying up a building; nay, more, he may be very capable of instructing persons under him to conduct the execution of his plans, but he certainly has no pretentions to a capability of writing either a description of the apparatus to be used or of the manner of using them. We are at all times desirous of finding some redeeming qualities in a work, but after a most careful examination of the few pages of which this book consists, we have not found one point to rest on. The engravings are execrable, out of proportion, without any information as to requisite strengths of materials or instruments. Perhaps our readers will be better able to appreciate the value of this work by a short extract which we take from the preface, and which may be called a sort of text to the remainder of the book. He is speaking of learning to build scaffolding, and recommends practising on small models, and goes on to say, "Use small ropes, and tie them up in the same way, without directions the better; if you have a little difficulty to learn you will remember it the longer; for if shewn, it appears so simple that you will be more likely to forget: learn, likewise, to tie ropes the different ways that you may meet with and the different splices, it is the way that I did at the beginning of my time, and I have always found it an advantage to me." We are not desirous of being thought critical as to the style of the language: the want of elegance we could readily forgive, if the work conveyed any practical information, but of this there is not one iota. We had heretofore an idea that books were in-

tended to teach, but now we are informed that to be shewn a thing would render it so simple that we should forget it, or, in other words, we are to rake about in the dark, and if we find what we desire we shall be fortunate; for this reason, we presume, the *author* has avoided telling anything. The only credit we can give him is keeping to the text which we have quoted, for he has most certainly avoided giving any directions by which information can by possibility be gained; and if any one learns aught of the subject in question it must be from other sources than this book.

The Mathematical Calculator, or Tables of Logarithms of Numbers and of Logarithmic Lines and Tangents, with other Useful Tables, and an Introduction theoretical and practical. By Robert Wallace, A.M. Glasgow.

The practical application of logarithms to the general purposes of calculations is but little understood by those to whom such knowledge would be most peculiarly useful,—to engineers, surveyors, manufacturers, merchants, and others requiring extensive calculations, the general use of logarithms would be found a most admirable means of abridging labour. This work offers to the public a cheap and portable collection of logarithmic tables, which, like a slide rule, may be constantly carried in the pocket, and thus be at all times within reach to aid in effecting extensive calculations. The mere tables to the uninitiated, although printed in a portable form, would be useless, the compiler has therefore very properly applied himself, in the first place, to explain, in a familiar manner, the nature and use of logarithms, and has given a great variety of examples by which the learner will readily make himself acquainted with the subject, and with moderate exertion, quickly apply the tables to his various calcula-

tions. We confidently recommend the work as one which will prove highly useful to those who are desirous of saving time, by quickly obtaining results which are otherwise only to be effected by a laborious combination of figures.

NOTICE OF EXPIRED PATENTS,

(*Continued from p.* 60.)

William Bate, of Peterborough, Northamptonshire, Esq., for certain improvements in preparing hemp, flax, or other fibrous material, for spinning.—Sealed June 3, 1820.

Simion Teissier, of Paris, but at present residing in Bucklersbury, London, Merchant, for certain improvements in propelling vessels. Communicated to him by a foreigner residing abroad.—Sealed June 3, 1820.

Jacob Perkins, late of Philadelphia, America, but now residing at Austin Friars, London, Engineer, for certain improvements in the construction of fixed and portable pumps, such as pumps fixed for raising water from wells and other situations, or ships-pumps, or for portable pumps, which may be employed for garden-engines, or in engines for extinguishing fires, or other purposes.—Sealed June 3, 1820.

John Hague, of Great Pearl-street, Spitalfields, Middlesex, Engineer, for certain improvements in the making and constructing of steam-engines.—Sealed June 3, 1820.

John Wakefield, of Ancott's-place, Manchester, Lancashire, Engineer, for certain improvements in the construction of furnaces for boilers of various descriptions, and in the mode of feeding the same with fuel, which improvements are calculated to lessen the consumption of fuel, and to burn the smoke.—Sealed June 6, 1820.

William Kendrick, of Birmingham, Warwickshire, Chemist, for the manufacture of a liquid from materials now considered useless for that purpose, and the application of the same liquid to the tanning of hides and other articles requiring such process.—Sealed June 6, 1820.

Jonathan Brownell, of Sheffield, Yorkshire, Table-knife-cutter, for a method for better securing the blades of table-knives and forks in the handles, by means of caps being soldered upon the tangs, whether of iron, steel, or other material, after the handles are upon them. —Sealed June 8, 1820.—(*For copy of specification, see Repertory, Vol.* 44, *second series, p.* 330.)

LIST OF NEW PATENTS.

John Twisden, of Halberton, near Tiverton, in the County of Devon, Commander in the Royal Navy, for improvements applicable to inland navigation.—Sealed July 24, 1834.—(*Six months.*)

William Hale, of Colchester, in the County of Essex, Civil Engineer, for certain improvements in or on windmills, which improvements are applicable to other purposes.—Sealed July 26, 1834.—(*Six months.*)

William Coles, of Charing Cross, in the County of Middlesex, Esquire, for a certain specific or remedy for the cure, alleviation, or prevention of rheumatic, gouty, or other affections arising from colds or other causes.—Sealed July 26, 1834.—(*Six months.*)

Pierre Barthelemy Guimbert Debac, of Acre Lane, Brixton, in the County of Surrey, Professor of Languages and Mathematics, for an improved machine for weighing, with the means of keeping a register of the operations of the instrument.—Sealed July 26, 1834.—(*Six months.*)

John Chanter, of Stamford Street, Blackfriars, in the County of Surrey, Gentleman, and William Witty, of Basford Cottage, near Newcastle, in the County of Stafford, Engineer, for an improved method or improved methods of abstracting heat from steam and other vapours and fluids applicable to stills, breweries, and other useful purposes.—Sealed July 26, 1834.—(*Six months.*)

Thomas John Hamilton, Earl of Orkney, and John Easter, Engineer, both of Taplow, in the County of Bucks, for certain improvements in machinery or apparatus for propelling vessels on water.—Sealed July 26, 1834.—(*Six months.*)

Edmund Youlden, of Exmouth, Schoolmaster, for improvements in preventing or curing what are termed smokey chimneys.—Sealed August 5, 1834.—(*Two months.*)

Lemuel Wellman Wright, of Sloane Terrace, in the Parish of St. Luke, Chelsea, in the County of Middlesex, Engineer, for certain improvements in machinery or apparatus for refrigerating fluids.—Sealed August 7, 1834.—(*Six months.*)

Thomas Gaunt, of Bridport Place, Hoxton, in the county of Middlesex, Gentleman, for an improvement in earthware pans or basins of water-closets and certain other earthenware vessels to which such improvement is applicable.—Sealed August 12, 1834.—(*Six months.*)

Andrew Hall, of Manchester, in the County of Lancaster, Manufacturer, and John Slark the younger, of Chorlton-upon-Medlock, in the said county, Putter-out, for improvements in the construction of looms for weaving by hand or power.—Sealed August 12, 1834.—(*Six months.*)

James Ward, of Stratford-upon-Avon, in the County of Warwick, Watchmaker, for improvements in apparatus for ventilating buildings and other places.—Sealed August 12, 1834.—(*Six months.*)

Charles Arter, of Havant, in the County of Southampton, Plumber and Glazier, for certain improvements on cocks or taps for drawing off liquids.—Sealed August 12, 1834.—(*Six months.*)

James Pedder, of New Radford, in the County of Nottingham, Machinist, for certain improvements applicable to certain machinery for making bobbin net lace for the purpose of making ornamented bobbin net lace by the application to such machinery of any or all of the said improvements.—Sealed August 13, 1834.—(*Six months.*)

William Bruce, of the City of Edinburgh, Scotland, Baker, for improvements in machinery or apparatus for making ship and other biscuit or bread. Communicated by a foreigner residing abroad.—Sealed August 14, 1834. (*Six months.*)

Jacob Perkins, of Fleet Street, in the City of Lon-

don, Engineer, for improvements in the apparatus and means for producing ice and in cooling fluids.—Sealed August 14, 1834.—(*Six months.*)

Thomas De la Rue, of Finsbury Place, in the County of Middlesex, Fancy Stationer, for an improvement or improvements in manufacturing or preparing embossed paper hangings. — Sealed August 15, 1834. — (*Six months.*)

James Slater, of Salford, in the County of Lancaster, Bleacher, for certain improvements in addition to certain improved machinery for bleaching linen and cotton goods. —Sealed August 23, 1834.—(*Six months.*)

George Child, of Brixton, in the County of Surrey, Gentleman, for an improvement or improvements in machinery for raising water and other liquids. Communicated by a foreigner residing abroad.—Sealed August 23, 1834.—(*Six months.*)

Webster Flocton, of Horsleydown, in the Borough of Southwark, Turpentine Distiller, for an improvement in manufacturing rosin.—Sealed August 23, 1834.—(*Six months.*)

Robert Stein, of Walcot Place, Lambeth, in the County of Surrey, Esquire, for certain improvements in certain engines to be worked by steam.—Sealed August 23, 1834.—(*Six months.*)

John Rapson, of Penryn, in the County of Cornwall, Engineer, for an improved apparatus for facilitating the steering of vessels of certain descriptions.—Sealed August 23, 1834.—(*Four months.*)

Keith Norman Thomson, of Holland Street, Blackfriars, in the County of Surrey, Cork Manufacturer, for certain improvements in machinery for cutting or making corks and bungs. — Sealed August 23, 1834. — (*Six months.*)

THE

REPERTORY

OF

PATENT INVENTIONS.

No. X. NEW SERIES.—OCTOBER, 1834.

Specification of the Patent granted to Edwin Appleby, *of Doncaster, in the County of York, Iron Founder, for certain Improvements on Steam and other Engines.*—Sealed January 29, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Edwin Appleby, do hereby declare the nature of my said invention to consist,

Firstly, In so constructing the boiler of a steam-engine, that the fire-place and lower part of the flue shall be surrounded with water in such a manner that the passages upwards through the water may allow the current of flame and of heated air, arising from the fire, to be alternately diverged and converged in its ascent, and thus, by alternate rarefactions and condensations of the current, as well as by numerous reverberations, the greatest part of the heat may be transmitted to the water, while the heated current passes through a short distance of space, and no more heat allowed to escape up the chimney than is requisite for promoting a good draft.

Secondly, In feeding a boiler with water from a forcing-pump, through a pipe in which is a stop-cock opened and shut by a lever, acted on by a float on the surface of the water in the boiler, in a part of which pipe, outside of the boiler there is a valve, kept down by a weight rather more than sufficient to resist the pressure of the steam in the boiler, which loaded valve will rise and allow the escape of all the water that the pump delivers, more than the boiler requires.

Thirdly, In placing within the boiler, in contact with the flue, at a little below the proper level of the water, the closed end of a safety-tube, made of metal or of a metallic compound, fusible at a heat somewhat higher than the greatest heat of the water, and in leaving the other end of the safety-tube open, having its neck fixed into a whistle, trumpet, or other contrivance for giving alarm, attached to the outside of the boiler, so that should the water be suffered to sink below the closed end of the safety-tube, the same shall be melted by the heat of the flue, and the steam allowed to escape through the whistle or other contrivance, and sound an alarm to indicate the necessity of immediately quenching the fire.

Fourthly, In the fixing of two winged, or leaf-formed pistons, upon a shaft turning in the axis of the working cylinder of a steam-engine, the wings projecting from opposite sides of the shaft, and librating in two separate compartments, about three-eights of a revolution around the axis of the cylinder, the compartments being formed by placing two wedge-like partitions within the cylinder; and in making the shaft to work through stuffing-boxes in the ends of the cylinder, and in fixing a crank upon one end of the shaft, to transfer, by means of a connecting-rod, the librating motion of the pair of wings to a rotating crank fixed on the main-shaft of the engine; and by this arrangement to produce a more equal action on the main-shaft, by the change of position of the librating crank following, in part, the change of position of the

revolving-crank, while the pressure of steam on the piston is not affected by this change of position, but which operates by reducing the leverage, and thereby increasing the power of the impelling-crank when the leverage of the impelled crank is reduced, and thereby requires more power to drive it, and thus much of the irregularity is avoided, which arises from a comparatively uniform force of a piston sliding longitudinally in a cylinder, acting on the varying leverage of a revolving-crank, and therefore I require a less fly-wheel for passing the crank over the centres.

Fifthly, In producing a similar equable action on the main-crank, by hinging the two librating wing-formed pistons and a pair of concentric shafts together, so that one shaft shall work partly within the other, and that one wing shall be fixed to one shaft passing through a stuffing-box in one end of the cylinder, and the other wing fixed to the other shaft passing through a stuffing-box in the other end of the cylinder, and in fixing a crank upon each shaft to communicate the librating motions of the pistons by means of two connecting-rods to two revolving-cranks fixed on the main-shaft, whereby the two pistons may be made to act simultaneously upon the main-shaft, while they both move towards or both recede from the main-shaft, and in this case, no partitions will be requisite to divide the cylinder into two compartments, the pistons in all situations acting as mutual abutments to each other, and when a fly-wheel is to be avoided, in using the hinged pistons in two compartments of a cylinder to act on cranks fixed at right angles on the main shaft.

Sixthly, In constructing the working-valves of a steam-engine in a cylindrical form librating in semi-cylindrical beds, each bed having at the bottom, lying longitudinally, a long narrow aperture opening into the working-cylinder, by which a communication is established from the steam-pipe through the valve and aperture into the cylinder, and alternately from the cylinder through the aperture and

valve into the eduction-pipe, the alternation being effected by a librating motion of the valve, presenting a long narrow groove or cavity in the side of the valve, alternately to include the aperture and the mouth of each of the respective pipes for steam and for eduction, and for keeping the said valve firmly in its bed, with proper freedom of motion, by means of a cap pressed upon it, regulated by adjusting-screws, by which construction the valve requires no steam-tight case to inclose it, and leakage can at all times be seen, and the valve be easily lubricated or taken out for repairs.

Seventhly, In packing the stuffing-box of a steam-engine with a cord, taking one turn around the piston-rod or shaft, the two ends of which cord pass out through two grooves in opposite directions made in the rim of the stuffing-box, and in its cap, the recesses and grooves in the stuffing-box, and in the cap, corresponding to the half dimensions of the cord; and in causing each end of the cord to be attached to a spring to keep up a constant tension of the cord, in order to its embracing the piston-rod or shaft sufficiently tight to prevent the escape of steam without creating much friction.

And, eighthly, In making an engine to be worked by the hydrostatic pressure of water, by means of my librating wing-formed pistons, combined with common cocks, instead of with my librating-valves. And I do further declare, that the manner in which I carry these several parts of my said invention into effect, is particularly set forth and explained in the following description thereof, reference being had to the drawings hereunto annexed, and to the figures, letters, and numbers herein contained (that is to say):

Description of the Drawing.

Fig. 1, represents a vertical section through the middle of my steam-boiler, and a view of the parts that would be seen beyond such a section.

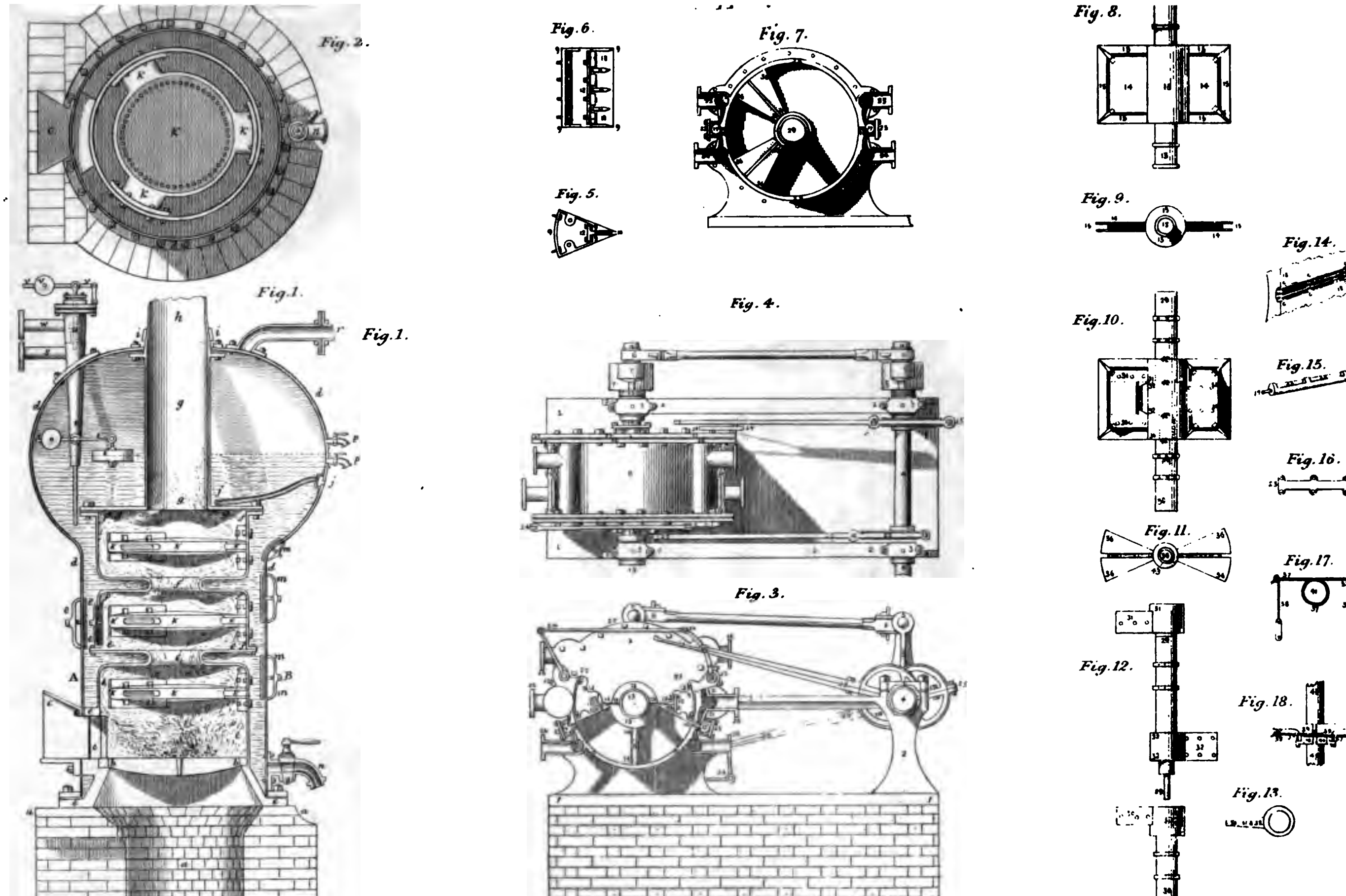


Fig. 2.
Fig. 1.
Fig. 1.
Fig. 6.
Fig. 7.
Fig. 5.
Fig. 4.
Fig. 3.
Fig. 8.
Fig. 9.
Fig. 14.
Fig. 10.
Fig. 15.
Fig. 16.
Fig. 11.
Fig. 17.
Fig. 12.
Fig. 18.
Fig. 13.

Fig. 2, a horizontal section of the boiler from A to B, of fig. 1, with a view of parts below the section.

Fig. 3, a side-view of a librating steam-engine containing my two winged or leaf-formed pistons, fixed upon one shaft, librating within a cylinder divided into two compartments by two wedge-like partitions, combined with four of my librating valves; the lower compartment and valves being represented in section, and part of the frame broken away.

Fig. 4, plan of the same.

Fig. 5, edge-view of the wedge-like partition.

Fig. 6, longitudinal section through the middle of the same.

Fig. 7, a vertical section through the cylinder and valves of a librating steam engine, formed of my two-hinged pistons and shafts, combined with two of my librating valves.

Fig. 8, a side-view of the pair of pistons fixed on the shaft, and one cheek removed to exhibit a method of applying metallic packing.

Fig. 9, an edge-view of the pair of pistons, shewing the groove for the packing to lie in.

Fig. 10, side-view of the pair of hinged-pistons and shafts, and one cheek removed to shew the form of metallic packing best adapted to this construction of piston.

Fig. 11, edge-view of the same, with groove for the packing to lie in.

Fig. 12, side-view of the knuckles, shewn separately with projections or tangs cast to them, upon which the pistons are to be fastened, mortices being cast in the pistons to receive these projections.

Fig. 13, edge-view of the same.

Fig. 14, a perspective view of the bed in which the valve librates, shewing a partition to divide the long narrow apertures into two lengths for the sake of the strength of the cylinder.

Fig. 15, perspective view of the librating valve, shewing

the groove or recess, also divided into two lengths, corresponding with those in the apertures of the beds.

Fig. 16, plan of the back of the cap to keep the valve in its bed.

Fig. 17, side-view of the cord-packing and springs.

Fig. 18, horizontal section through part of the stuffing-box and cap, to lay bare the cord-packing.

It is to be noted, that in all the figures the same letters and numbers of reference signify the same parts.

a, the ash-pit and base of the boiler. *b*, the fire-bars. *c*, the fire doorway. *d*, the outside case of the boiler, made of rolled plate iron rivetted together. *e*, *f*, and *g*, the inside case of the boiler constituting the fire-sides and flue, of cast or wrought iron, the lower part, *e*, being made in one piece, with a flanch at bottom, bolted to a flanch at the bottom of the outside case, *d*, the second part, *f*, being made in another piece, is bolted upon the lower piece, and the third part, *g*, made also in one piece, is bolted upon the second piece. The thickness represented in the drawing of this inside case, is that proper for cast-iron, which in this construction would be perfectly safe for a boiler of small dimensions, but for larger boilers, or for any high pressures, wrought-iron should be used. *h*, a continuation of the flue towards the chimney, the joining with the piece, *g*, being made tight by a hoop falling over the two conical parts which meet together, a similar mode of joining may be made between the top or the piece, *h*, and the further continuation of the flue, so that the piece *h*, may be taken away at pleasure, by merely lifting up the hoops, without disturbing the rest of the flue, and thus access to the inside of the piece, *g*, is easily obtained, for cleansing the same. *i*, the hoop covering the place of meeting of the flue-pieces. *j*, the safety-tube and whistle, fixed in the outside case of the boiler. *k*, three centicular compartments from each of which proceed three tubes, terminating in flanches, which are bolted within the inside boiler-case,

opposite to apertures corresponding with those of the proceeding tubes, so as to allow a free communication of the water in the centicular compartments, with that in the other part of the boiler. The rim forming the edge of the compartment, together with the three projecting tubes, are most economically made of cast-iron, and the top and bottom plates of sheet-iron, rivetted through the rim and through the top and bottom of the tubes: but I do not confine myself to cast-iron, nor to the centicular figure, since nearly the same objects might be attained by the top and bottom of the compartment being flat or concave, and the whole may be made of wrought-iron, or of copper. *l*, two apertures opposite each other, the one through the outside case, and the other through the inside case of the boiler, both apertures being closed by doors, held in their places by screws and cross-bars. Two pair of such apertures at nearly opposite sides of the boiler, will be sufficient for introducing a broom to sweep all the parts of the flue, not accessible from above, by the removal of the flue-piece, *h*, or from below, by taking out some of the fire-bars. *m*, apertures through the outside case of the boiler, closed by doors, held in their places by screws and cross-bars, through which apertures, when the doors are removed, access will be had to the inside of the boiler, to clear away any filth or concretion which may there accumulate. Nine such apertures opposite to the nine proceeding tubes of the three centicular compartments, together with one common man-hole at the top, will afford access to all the interior of a boiler of the construction represented in the drawing. *n*, a cock to draw off the water. *p*, two gauge-cocks. *r*, the steam-pipe leading to the engine. *s*, the pipe leading from the feeding-pump. *t*, the cock-arm and float, to regulate the supply of water to the boiler. *u*, the valve to let off the surplus water, shewn by dotted lines. *v*, the lever and weight to load the valve. *w*, the pipe to carry off the surplus water.

Figs. 3 and 4, 1, the base or foundation-plate of the steam-engine, resting on brick-work, or masonry. 2, the frame supporting the bearings of the shafts. 3, the bearings. 4, the main shaft. 5, the crank on the main shaft. 6, the connecting-rod. 7, the crank on the piston shaft. 8, the working cylinder. 9, the wedge-like partitions dividing the interior of the cylinder into two compartments, the lower one of which compartments is shewn as open, and the upper one as closed, but they are to be understood as being counterparts to each other. (See also figs. 5 and 6.) 10, the packing-groove for the packing against the shaft. 11, partitions in the packing-groove for the sake of strength to resist the pressure of the packing; these partitions terminate on thin edges, at a little distance from the shaft, so as to leave the packing entire throughout the whole length of the groove. 12, a cap and adjusting-screws to follow the packing, which packing might be of hemp, either faced or not faced, with metal at the part rubbing against the shaft. 13, (figs. 3, 4, 8, and 9,) the piston shaft. 13, the two winged or leaf-pistons, fixed on the shaft. 15, the packing-groove and metallic packing around the edge of the leaves. 16, wedges and springs to force out the packing. 17, (figs. 3, 4, 14, 15, and 16,) the librating valves. 18, the beds in which the valves librate. 19, the aperture from the steam-pipe into the bed. 20, the aperture from the bed into the cylinder. 21, the aperture from the bed into the eduction-pipe. 22, the longitudinal groove in the valve, to form the communication alternately between the steam-pipe and the cylinder, and between the cylinder and the eduction-pipe. 23, the cap and adjusting-screws, for holding the librating-valve in its bed. 24, (figs. 3 and 4,) levers and connecting-rods for working the valves. 25, hand-geer and eccentrics. 26, the flanches of the cylinder and of the steam and eduction-pipes. 27, the caps or doors enclosing the two ends of the compartments of the cylinder. 28, (fig. 7, 10, 11, 12, and 13,) the working

cylinder without any partitions. 29, the inner shaft, which, in fig. 10, is partly shewn by dotted lines, as if seen through the outer shaft. 30, the outer shaft, cast in a piece, with one part of the double knuckle, together with its tang. 31, the other part of the double knuckle, with its tang. 32, the single knuckle fixed upon the inner shaft together with its tang. The tangs are represented by dotted lines in figs. 7, 10, and 11, and shewn in figs. 12, and 13. 33, fig. 7, the steam-pipes and inlets to the valves. 34, the eduction-pipes and passages from the valves. 35, the apertures into the cylinder. 36, the pistons increasing in thickness towards the extremities, in order to nearly fill up the space between the pistons at the moment of opening the steam-valve, so that but little steam may be wasted at the change of stroke. It is unnecessary here to repeat the description of the valves, flanches, and other parts; they having been clearly described under figs. 3, 4, 14, 15, and 16, nor to give any drawing of the cranks and connecting-rods, it will be sufficient to say that there must be a crank on the outer shaft at one end of the cylinder, and another crank on the inner shaft at the other end of the cylinder, and two connecting-rods communicating the simultaneous motion of the pistons to two cranks on the main shaft; and when a fly-wheel is to be avoided, the pistons of fig. 3, are to be hinged together and to a pair of shafts, and caused to act on two cranks fixed at right angles on the main shaft. 37, figs. 17 and 18, the cord packing. 38, the springs to keep the cord packing in a state of tension. 39, the stuffing-box. 40, the cap of the stuffing-box. 41, the piston-shaft or piston-rod. 42, fig. 10, washers of thin brass put in between the knuckles, which, when by long wear, they do not fill up the spaces, may be removed, and thicker washers placed in their stead. 43, fig. 11, ferules of thin tube, similar to telescope tubing, put into the two knuckles which work upon the inner shaft, which fer-

rules, when too much worn, may be replaced by others of a proper thickness to fill up the spaces.

And I do further declare, that the boiler and engine hereinbefore described, are such as I make to produce the power of about ten or twelve horses, when worked with steam of about two atmospheres of pressure, without condensing; and that from these dimensions and proportions, measured by the scale laid down in the drawings, a competent steam-engine maker, can calculate the dimensions and proportions required for engines of other degrees of power, and other heights of pressure, used with or without condensing. And, also, when the librating-pistons are applied to a water-pressure engine, any person well acquainted with the making of such engines, will know how to calculate the dimensions due to the given height of the water, and work required to be performed.

And I do further declare, that for boilers of large dimensions, I increase the numbers and the diameters of the centicular compartments to diverge and dilate more extensively and more frequently, the ascending current of flame and of heated air, and also increase the number of the intermediate necks or inward projections of the inner boiler sides, in order to contract and to condense the said current, so that the numbers of the condensations, dilations, and reverbations of the ascending current of flame and of heated air, may correspond with the magnitude of the furnace from which the current arises, and thereby to extricate all the heat not necessary to a good draught in the chimney.

And I do lastly declare, that the points of novelty and utility, which I claim to have invented, are the eight parts of my said invention herein first declared, as carried into effect in the manner herein described, the other common parts of steam-engines being shewn and referred to, merely in elucidation of my invention.—In witness whereof, &c.

Enrolled July 29, 1833.

Specification of the Patent granted to NICHOLAS TROUGHTON, *of Swansea, in the County of Glamorgan, Copper Smelter, for an Improvement or Improvements in Preparing the Materials for, and in Producing a Cement applicable to, building and other purposes, which he denominates Metallic Cement.*— Sealed September 8, 1832.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.— *Now know ye,* that in compliance with the said proviso, I, the said Nicholas Troughton, do hereby declare the nature of my said invention to consist, First, in washing the stamped or powdered slag of which the cement is to be partly composed, in order to separate from it the mineral which discolours it when exposed to the action of the atmosphere. Secondly, in a new mode of sifting the said powder, so as to separate it into sorts of different degrees of fineness. Thirdly, in a new mode of combining it with the lime and other materials, if any, when in a dry state, in order to reduce it to a state fit for working up with water for use. And, Fourthly, in working it up with water for use, by means of machines and apparatus adapted to perform each process hereinbefore mentioned. And, in further compliance with the said proviso, I, the said Nicholas Troughton, do hereby describe the manner in which my said invention is to be performed, by the following description thereof, reference being had to the drawing annexed, and to the figures and letters marked thereon (that is to say):

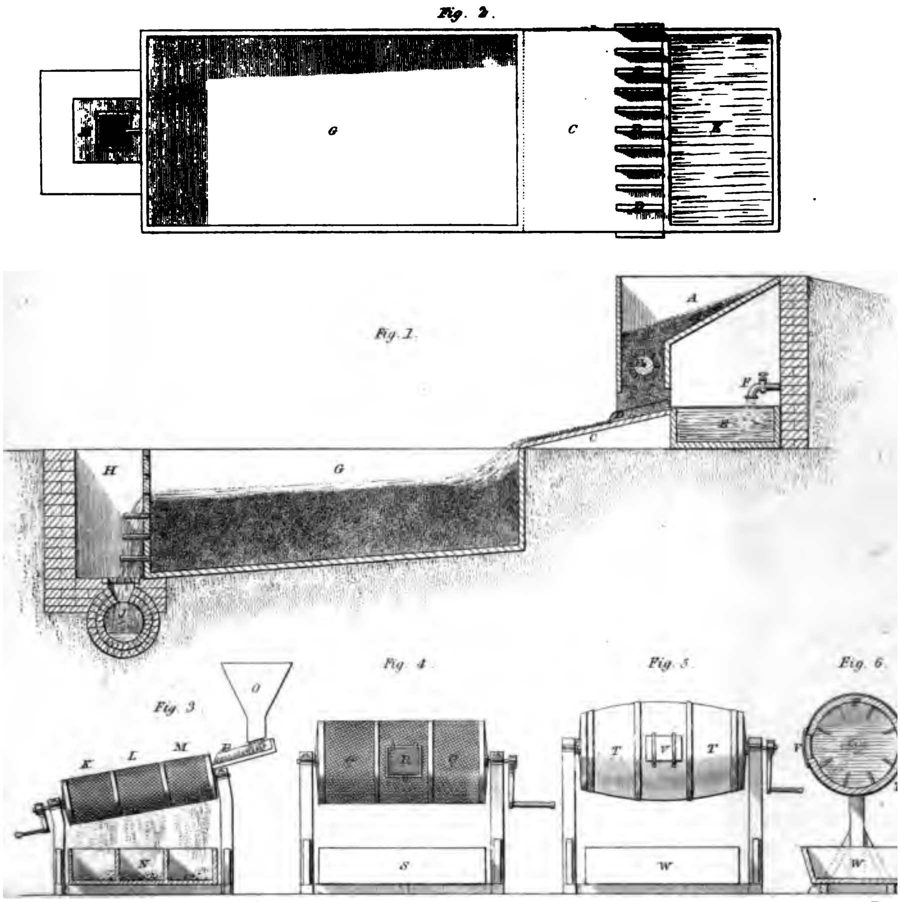
And whereas, previously to entering upon the description of the drawings, the various figures of which represent the mode of carrying into effect the improvements alluded to under the first, second, third, and fourth heads of my said invention, it is necessary to premise that various slags, the refuse of smelting furnaces, have

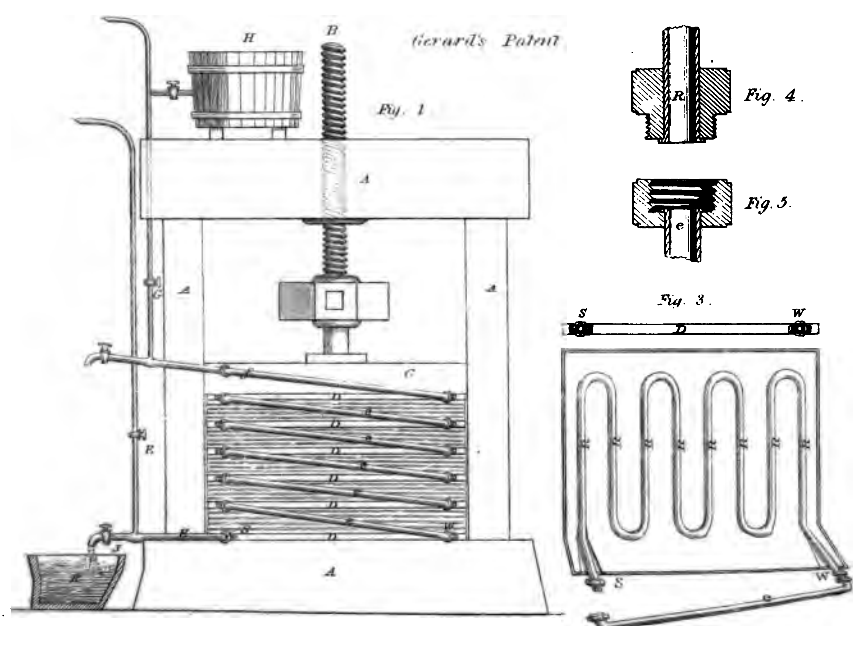
been heretofore suggested, as useful for the purpose of being reduced to powder, in order to be converted into cement. And whereas, the slags from copper smelting furnaces have been found the best adapted for, and, beyond the memory of man, have been used in a powdered state, for mixing with lime, to form a cement for building and other purposes. But whereas, it is found that the particles of copper which remain in the slag after the operation of smelting, discolour the cement made from such powdered slag, when exposed to the action of the atmosphere; and it is for the purpose of extracting or separating the aforesaid particles of copper from the powdered slag, that the process of washing hereinbefore alluded to, as the first head of my invention, is had recourse to.

Description of the Drawing.

Fig. 1, represents a section of the apparatus I use to wash the powdered slag, which in all cases I reduce to powder, in the first instance, by one of the ordinary modes of stamping or grinding. A, is a hopper, into which I put a quantity of the said powdered slag. B, is a small cylinder, furnished with spikes or teeth over its external surface, and kept constantly revolving in the lower part or bottom of the hopper, in order to cause the powdered slag to fall gradually from the hopper. C, is a board placed on an inclined plane under the hopper, and furnished with short longitudinal divisions, one of which is shewn at D, to make separate channels for the water which performs the washing to run down. E, is a tank or reservoir of water, fed from any convenient source, by the cock F; this tank should be a little higher at the sides and back than the highest part of the inclined plane, C, so that the water introduced by the cock, F, may flow over the front edge of the tank, and run down the channels of the inclined plane, C. By this operation, the light powdered slag will be carried down

Troughton's Patent.





the inclined plane, while the pieces of copper contained in it will, by their weight, be left at the head of the trough, G, which trough is for the purpose of receiving the powdered slag so washed down the board or inclined plane as aforesaid. This trough is furnished with plugs at different heights, at one end, to let off the water above the powdered slag, as it collects in the trough. H, is a space or open chamber, to enable a workman to get at the plugs; and J, is a gutter or drain to carry off the waste water so let off as aforesaid.

Fig. 2, is a plan of the tank, B, inclined plane, C, and trough, G; and similar letters being used to denote similar parts in both this and the foregoing figure, no further explanation will be necessary.

Fig. 3, represents a large open work wire cylinder, with meshes of the size of about ten to the square inch at K, twenty to the square inch at L, and twenty-four to the square inch at M, mounted on an axis at an angle of elevation from the floor, such as here shewn, and placed over a box, N, containing three compartments, one under each variety of mesh. O, is a hopper with a shoot or spout, P, from which the cylinder is fed with washed powdered slag: this cylinder being turned by hand or otherwise, the slag is sifted through into the box below, each compartment receiving powder of a different degree of fineness. The powder which falls into the compartment under K, is for the first coat, whether of inside or outside work, and should be mixed with two parts of slacked lime to four parts of slag. The powdered slag which is collected under L, is for the second and last coat of outside work, and should be mixed with an equal quantity of slacked lime: and that which is collected under M, is for the last coat for inside work, and should also be mixed with an equal quantity of slacked lime.

Fig. 4, represents what I call the mixer or machine, in which the slacked lime and powdered and sifted slag are mixed together. Q, is a large wire open work cylinder

Jacques Francois Victor Gerard, do hereby describe the manner in which the said invention is to be performed, by the following statement thereof, reference being had to the drawing annexed, and to the figures and letters marked thereon (that is to say):

Description of the Drawing.

Fig. 1, represents a front-elevation of the said invention. A, A, A, A, is the frame-work of an ordinary hot-presser's press; C, being the top or cover acted upon by the screw, B, in the usual way; the part coloured pink* represents the cloth under pressure. D, D, D, D, D, D, D, D, are eight hollow metal shelves or flat boxes, each containing a long or serpentine pipe embedded in wood, answering the purpose and supplying the place of the ordinary hot metal plates. E, E, E, E, E, E, E, are pipes of communication leading from the serpentine pipe in one shelf to the serpentine pipe in the shelves next adjoining. E, is a steam pipe leading from any ordinary boiler; and *f*, G, is an exit pipe leading into a condenser. J, may be called a waste pipe though its use is two-fold, as will be explained hereafter. K, is a tank to receive the waste water; and H, is a supplying-tank for cold water.

Before I proceed to describe the mode of putting the said invention into operation, I must describe more particularly the hollow shelves, marked D, and their internal arrangement, whereby I am enabled to keep up the temperature to any required degree of heat.

Fig. 2, represents a plan of one of the said shelves or flat boxes, with its top or upper side removed, in order to shew the serpentine pipe within it. Supposing this to be a plan of the bottom shelf, S, is the place where the steam-pipe, E, is connected with the serpentine pipe, R, which pipe, extending in a serpentine direction, as here shewn, from one end to the other of the shelf, finally makes its exit from the shelf again at W, where an aper-

* This will be evident in the engraving though not coloured.

ture is made for it considerably wider than the serpentine pipe itself, in order to admit of adjustment: a similar provision is made also at S. When the serpentine pipe leaves the shelf at W, it becomes one of the communication pipes marked *e*, in fig. 1, and passes in a slanting direction upwards, to become the steam admission-pipe, for the serpentine pipe in the shelf next above it, where it enters a similar serpentine pipe to that in the hollow shelf below it, and so on through the whole series of hollow shelves, until at length it becomes the exit-pipe, *f*, communicating with G, which leads to the condenser. It should be observed here, that the serpentine pipe in the hollow shelf should be laid in a wooden bed hollowed out to receive it, and here shewn coloured brown.

Fig. 3, is a front-view of one of the hollow shelves. It is only necessary further to state, that the pipes of communication marked *e*, are united to the serpentine pipes, at each end, by ordinary screw nuts, rings, and washers, shewn separately, at figs. 4 and 5.

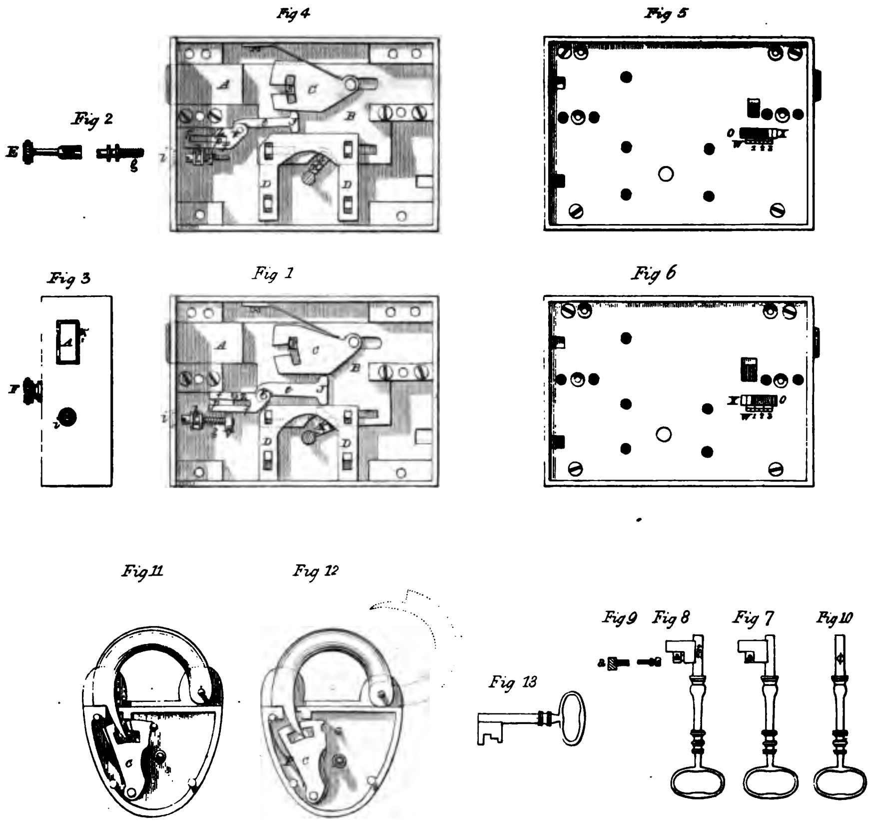
In order to put the said invention into operation the cloth should be folded over the cards in the usual manner, and one of the hollow shelves placed wherever a hot metal-plate would be placed on the old plan: the pipes of communication, marked *e*, should then be screwed on as shown in fig. 1, and steam admitted through the steam pipe, E, into the serpentine pipe of the lower shelf or box whence it will find its way from shelf to shelf till it reaches the exit pipe, G, through which it will pass off into the condenser. When the cloth has been sufficiently pressed and heated the steam must be shut off by the cock at E; the cock at J, must be opened and cold water admitted from the tank, H, into the pipe, G, and allowed to flow through the apparatus into the tank, K, until the cloth be sufficiently cooled for removal; when a fresh supply of cloth having been inserted, as before, the heat-

ing and cooling processes are repeated, giving a much better finish to the cloth than the method of hot-pressing now in use, and in much less time.

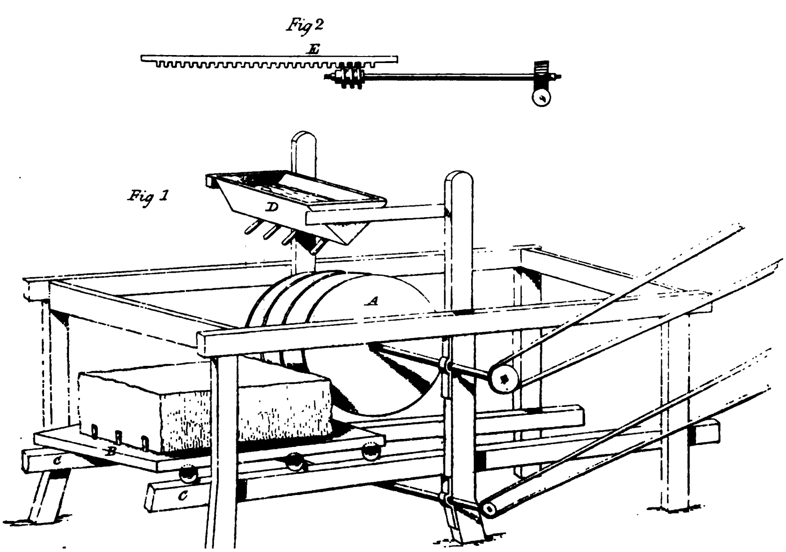
Now whereas it is evident that hot air may be used instead of steam for the purposes of the said invention, and in an exactly similar apparatus, but I prefer steam. And I claim as the said invention the following improvements; (that is to say,) First, heating the cloth or other substance when under pressure by means of hollow shelves or flat boxes with internal serpentine or other steam pipes surrounded by wooden or other the like conducting media as hereinbefore described, whereby I am enabled to secure the continuance of the heat at any required temperature for any given time without the risk of singeing the cards or the fabric under pressure. And, Secondly, the arrangement of the tanks H and K, by which I am enabled to cool the apparatus and the cloth or other fabric as soon as it has been sufficiently pressed, so that it may be removed without loss of time, while a much higher finish is retained upon the face of the fabric thereby; and such invention being, to the best of my knowledge and belief, entirely new and never before used within that part of his said Majesty's United Kingdom of Great Britain and Ireland called England, his said dominion of Wales, and town of Berwick-upon-Tweed; I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply in all respects fully and without reserve or disguise with the proviso in the said hereinbefore in part recited letters patent contained, wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.—In witness whereof, &c.

Enrolled August 8, 1834.

Parsons' Patent



Wildes' Patent



Specification of the Patent granted to THOMAS PARSONS, *of Newport, in the County of Salop, Gentleman, for certain Improvements in Locks for Fastenings.*—Sealed December 3, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said Thomas Parsons, do hereby declare the nature of my said invention to consist, First, in introducing a moveable support or prop between the tumbler which intercepts the motion of the bolt and the tumbler upon which the key acts, which moveable support is capable of adjustment, for the purpose of requiring a longer or shorter bit to the key, according to the position of the said moveable support. Secondly, in a mode of adjusting at pleasure the bit of the key to suit the situation of the moveable support aforesaid. And, Lastly, in a new application of what I call lever-tumblers, to padlocks and box-locks. And in further compliance with the said proviso, I the said Thomas Parsons, do hereby describe the manner in which my said invention is to be performed, by the following statement thereof, reference being had to the drawing annexed, and to the figures and letters marked thereon (that is say):

Description of the Drawing.

Fig. 1, is a view of the interior of a lock with my said improvements. A, B, is the bolt. C, is what I call the lever-tumbler. S, the stud or catch on the bolt, which catches in the lever-tumbler. D, D, is what I call the key-tumbler, which moves vertically: the bolt is here shewn as thrown back, and the key, K, inactive. J, is the moveable prop or support, which constitutes one of my said improvements. It will be seen that the lever-tumbler, C, rests upon this support, J, which I call the

prop; and the prop in turn is supported on the key-tumbler, D, D. The prop, J, is connected by means of the arm, *e*, to the slide, *f*, *f*, at the joint, *r*. This slide has a slot in it working on the pin or guide, *p*, fixed into the middle plate of the lock, on which pin it slides to and fro by means of the screw, *g*, working in the boss, V. The screw, *g*, is kept stationary by means of the crutch, *h*, working between the two collars, shewn near the screw-head. *i*, is an aperture for introducing the turn-screw, E, shewn at fig. 2. Now it is evident, from this arrangement, that according as the screw, *g*, is turned one way or the other, so the prop, J, will be drawn farther from or pushed nearer to the fulcrum of the lever-tumbler, C; and according to its place under the lever-tumbler, C, so will the key-tumbler, D, D, require to be lifted more or less in order to free the bolt, and will consequently require a longer or shorter bit to the key for that purpose.

Fig. 3, is a view of the selvage-end of the lock; and it may be as well here to observe, that similar letters are used to denote similar parts in all the figures, so that much repetition of description is avoided. F, is a small milled nut or handle on the front plate of the lock, which is removable for purposes hereinafter explained.

Fig. 4, is another view of the interior of the lock, the key being in action and the bolt ready to be shot. In this view the prop, J, is shewn drawn to the furthest point from the fulcrum of the lever-tumbler, C, and the bit of the key elongated in proportion, as will be more particularly explained hereafter.

Fig. 5, is a view of the opposite side of the lock to that shewn at figs. 1 and 4, with the front plate removed in order to shew the index, X, and scale, W; the index, X, is attached at Z, to the slide, *f*, *f*, and works through the slot, O, so that by removing the front plate, it may be seen exactly how far the prop, J, is removed from the fulcrum, and, consequently, the degree of extension re-

quired in the bit of the key, in order that it may act correctly upon the lever-tumbler, c.

Fig. 6, is a similar view to fig. 5, but shews the index at the other end of the scale.

Fig. 7, is the key; *a*, being the adjustable part of the bit.

Fig. 8, shews that part of the bit extended.

Fig. 9, shews the moveable part of the bit, in section, and the collared adjusting-screw which acts upon it, separately, there being a female screw in the neck of the piece, *a*, to receive the screw. The letter *t*, in fig. 8, shews the pin passing through the side of the stem of the key into the groove made by the collar on the screw, and which causes the screw, when turned, to push out or draw in the part, *a*, at pleasure.

Fig. 10, is a back-view of the key, shewing the head of the screw; and it is only necessary further to add, that I make each degree of the scale, w, to correspond with one turn or more, or some fixed portion of one turn, of this screw.

Fig. 11, is a padlock, shewing the manner in which I apply two or more of the lever-tumblers aforesaid, to act as a bolt for that kind of fastening. This figure shews the tumblers, c, in the position they assume when freely acted upon by the springs, P, and the shakle therefore fast; and,

Fig. 12, shews the tumblers, c, correctly raised by the key and the shakle, at liberty. If either tumbler were raised too much or too little, it is evident the shakle would be prevented from being withdrawn by the tumbler, and, consequently, it would remain locked; any inaccuracy in the action of the key on the tumblers having the same effect on the shakle as it is well known to have when the tumblers are applied to a bolt.

Fig. 13, is the key required for the two tumblers shewn in the drawing.

Now whereas it is evident that my invention, as regards

the prop, is susceptible of many modifications, and would apply equally as well between two tumblers working vertically, as it does between one lever and one vertical tumbler, provided one or both of their respective edges acted upon by the prop be inclined planes. And whereas the prop itself might be made to act as a lever. And whereas the lever-tumblers hereinbefore described as applied to padlocks, are equally applicable to box-locks. But whereas I claim as my invention, First, a moveable or adjustable prop, placed as aforesaid, for the purposes aforesaid; and the slide, *f*, *f*, and screw, *g*, as connected therewith. Secondly, the adjustable part, *a*, of the bit of the key, with its adjusting-screw, and its reference to the index and scale, x, w. And, Lastly, the manner hereinbefore described of applying the aforesaid lever-tumblers to act as a bolt to padlocks and box-locks. And such my invention being, to the best of my knowledge and belief, entirely new and never before used within that part of his said Majesty's United Kingdom of Great Britain and Ireland called England, his said dominion of Wales, or town of Berwick-upon-Tweed, or in any of his said Majesty's Colonies and Plantations abroad; I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply, in all respects, fully and without reserve or disguise, with the proviso in the said hereinbefore in part recited letters patent contained, wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.—In witness whereof, &c.

Enrolled June 3, 1834.

Specification of the Patent granted to George Washington Wildes, *of Coleman Street, in the City of London, Merchant, for certain Improvements in Machinery for Cutting Marble and other Stone, and Cutting or Forming Mouldings or Groovings thereon.* —Sealed April 15, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said George Washington Wildes, do hereby declare that the nature of the said invention, and in what manner the same is to be performed, are particularly described and ascertained, in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

The sawing is performed by means of improved revolving circular metallic plates, smooth, or without teeth, upon the face or edge, operating by friction with sand and water upon the material to be cut; and the moulding, or grooving, and polishing, is effected by means of the improved revolving moulding and polishing cylinder, or wheel, operating in cutting mouldings by friction with sand and water, upon the surface to be wrought; and polishing by friction, in like manner, with putty, buff, pummice stone, or some other suitable material; videlicit, one or more circular metallic plates, smooth, or not serrated upon the face or cutting edge (copper or soft iron are deemed preferable) are securely fixed upon a horizontal shaft or spindle of iron of any required dimensions passing through the centre of the plate or plates, and supported at each end by a proper frame of wood, or of cast iron, upon which the shaft works. On one end of the shaft is a cog-wheel to connect it to the moving power, or a pulley and band; the last has been found to

answer best practically. Where two or more plates are used on the same shaft, they are secured at the proper distance from and parallel to each other, by circular metallic bands or washers, of a thickness adapted to the intended thickness of the slab or slabs to be cut, which bands are fitted upon and around the shaft, between the plates or saws. Under the shaft, at the distance of a little more than the radius of the plates or saws, is a carriage on friction-rollers or wheels, resting on a permanent railway, to support and carry forward the stone or marble to the plates or saws: it is moved either by a rack and pinion, or by weights and pulleys. Over the saws is fixed a hopper, filled with sand and water, which is carried by a conductor leading from an aperture in its bottom, to the saws at the point of their contact with the stone or marble. The plates or saws may be made of any required dimensions, and must be wrought to a uniform thickness throughout, with the cutting-edge smooth, or not serrated, and either rounded, bevelled, or flat. They are securely fixed upon the shaft, and subsequently turned in a lathe, to make them run with the greatest possible accuracy. The proper speed varies, according to the diameter, from about three hundred revolutions per minute for a saw of two feet diameter, down to one hundred and fifty revolutions per minute for a saw of four feet diameter.

The improved moulding and polishing cylinder, or wheel, is of any metal (cast iron is preferable for moulding, and some of the softer metals, and wood, for polishing), and of any requisite dimensions, having the converse of the intended moulding or grooving either cast or turned upon its surface or periphery, by means of which any series of mouldings or groovings can be wrought on a surface of marble or stone at one operation, and in like manner be polished. It is fixed upon a horizontal shaft passing through its axis, which is turned by a cog-wheel or pulley and band, connecting it to the

power, and operates on the material to be wrought, by revolving vertically against its surface in contact with sand and water, in cutting mouldings, and in contact with pummice stone, buff, or some other suitable material in polishing. The speed of the moulding-wheels may be greater than that of the saws nearly two-fold, and the polishing-wheels may be run at a higher speed than the moulding-wheels. A cylinder having a regular smooth surface is used in like manner for flatting, and for polishing a plain surface. The marble or stone is carried forward, and under the moulding and polishing cylinder, by a mechanical arrangement similar to that before described.

Description of the Drawing.

Fig. 1, A, the saws, or the moulding-cylinder, of cast-iron. B, the carriage to support and carry forward the marble or stone. C, C, the rails on which the carriage travels. D, the hopper, for sand and water; and E, the apparatus for advancing the carriage. The polishing cylinder is similar in form to the above, and used in like manner with polishing-powder, as putty, buff, &c., instead of sand, and is made of wood, or some of the softer metals.

The improvements claimed consist in the sawing of marble or other stone, by means of a revolving circular metallic plate, smooth, or not serrated, on the face or edge, and applied with sand and water, as is done with the straight saw; and also in making or forming upon surface or periphery of a metallic or wooden cylinder or wheel, the converse of the intended moulding or grooving, by means of which a series of mouldings or grooves can be wrought on a surface of marble or stone, at one operation, with sand and water; and in like manner polished with putty, buff, pummice stone, or other polishing material.—In witness whereof, &c.

Enrolled October 14, 1833.

PROGRESS OF SCIENCE

APPLIED TO THE ARTS AND MANUFACTURES, TO COMMERCE, AND TO AGRICULTURE.

REPORT ON THE PROGRESS AND PRESENT STATE OF OUR KNOWLEDGE OF HYDRAULICS AS A BRANCH OF ENGINEERING. BY GEORGE RENNIE, ESQ., F.R.S., &c. &c —Part I.—(Continued from p. 182.)—In the year 1801, M. Eytelwein, a gentleman well known to the public by his translation of M. Dubuat's work into German, (with important additions of his own,) published a valuable compendium of hydraulics, entitled *Handbuch der Mechanik und der Hydraulik,* in which he lays down the following rules.

1. That when water flows from a notch made in the side of a dam, its velocity is as the square of the height of the head of the water; that is, that the pressure and consequent height are as the square of the velocity, the proportional velocities being nearly the same as those of Bossut.
2. That the contraction of the fluid vein from a simple orifice in a thin plate is reduced to 0·64.
3. For additional pipes the coefficient is 0·65.
4. For a conical tube similar to the curve of contraction 0·98.
5. For the whole velocity due to the height, the coefficient by its square must be multiplied by 8·0458.
6. For an orifice the coefficient must be multiplied by 7·8.
7. For wide openings in bridges, sluices, &c., by 6·9.
8. For short pipes 6·6.
9. For openings in sluices without side walls 5·1.

Of the twenty-four chapters into which M. Eytelwein's* work is divided, the seventh is the most important. The late Dr. Thomas Young, in commenting upon this chapter, says:

"The simple theorem by which the velocity of a river is determined, appears to be the most valuable of M. Eytelweins's improvements, although the reasoning from which it is deduced is somewhat exceptionable. The friction is nearly as the square of the velocity, not because a number of particles proportional to the velocity is torn asunder in a time proportionally short,—for according to the analogy of solid bodies, no more force is destroyed by friction when the motion is rapid than when slow,—but because when a body is moving in lines of a given curvature the deflecting forces are as the squares of the velocities; and the particles of water in contact with the sides and

* See Nicholson's translation of Eytelwein's work.

bottom must be deflected, in consequence of the minute irregularities of the surfaces on which they slide, nearly in the same curvilinear path, whatever their velocity may be. At any rate (he continues) we may safely set out with this hypothesis, that the principal part of the friction is as the square of the velocity, and the friction is nearly the same at all depths*; for Professor Robison found that the time of oscillation of the fluid in a bent tube was not increased by increasing the pressure against the sides, being nearly the same when the principal part was situated horizontally, as when vertically. The friction will, however, vary, according to the surface of the fluid which is in contact with the solid, in proportion to the whole quantity of fluid; that is, the friction for any given quantity of water will be as the surface of the bottom and sides of a river directly, and as the whole quantity in the river inversely; or, supposing the whole quantity of water to be spread on a horizontal surface equal to the bottom and sides, the friction is inversely as the height at which the river would then stand, which is called the hydraulic mean depth."† It is, therefore, calculated that the velocities will be a mean proportional between the hydraulic mean depth and the fall, or $\frac{11}{10}$ths of the velocity per second.

Professor Robison informs us, that by the experiments of Mr. Watt on a canal 18 feet wide at the top, seven feet at the bottom, and four feet deep, having a fall of four inches per mile, the velocities were seventeen inches per second at the surface, fourteen inches per second in the middle, and ten inches per second at the bottom, making a mean velocity of fourteen inches per second; then finding the hydraulic mean depth, and dividing the area of the section by the perimeter, we have $\frac{50}{20\cdot 6}$, or $29\cdot 13$ inches; and the fall in two miles being 8 inches, we have $\sqrt{(8 \times 29\cdot 13)} = 15\cdot 26$ for the mean proportional of $\frac{11}{10}$ths, or $13\cdot 9$ inches, which agrees very nearly with Mr. Watt's velocity.

The Professor has, however, deduced from Dubuat's elaborate theories $12\cdot 568$ inches. But this simple theorem applies only to the straight and equable channels of a river. In a curved channel the theorem becomes more complicated; and from observations made in the Po, Arno, Rhine, and other rivers, there appears to be no general rule for the decrease of velocity going downwards. M. Eytelwein directs us to deduct from the superficial velocity $\frac{1}{130}$ for every foot of the whole depth. Dr. Young thinks $\frac{9}{10}$ths of the super-

* See my "Experiments on the Friction and Resistance of Fluids," Philosophical Transactions for 1831.

† See *Nicholson's Journal* for 1802, vol. iii. p. 31.

ficial velocity sufficient. According to Major Rennell, the windings of the river Ganges in a length of 60 miles are so numerous as to reduce the declivity of the bed to 4 inches per mile, the medium rate of motion being about 3 miles per hour, so that a mean hydraulic depth of thirty feet, as stated to be $\frac{4}{5}$ds of the velocity per second, will be 4·47 feet, or 3 miles per hour. Again, the river when full has thrice the volume of water in it, and its motion is also accelerated in the proportion of 5 to 3; and, assuming the hydraulic mean depth to be doubled at the time of the inundation, the velocity will be increased in the ratio of 7 to 5; but the inclination of the surface is probably increased also, and consequently produces a further velocity of from 1·4 to 1·7. M. Eytelwein agrees with Genneté*, that a river may absorb the whole of the water of another river equal in magnitude to itself, without producing any sensible elevation in its surface. This apparent paradox Genneté pretends to prove by experiments, from observing that the Danube absorbs the Inn, and the Rhine the Mayne rivers; but the author evidently has not attended to the fact, as may be witnessed in the junction of rivers in marshes and fenny countries,—the various rivers which run through the Pontine and other marshes in Italy, and in Cambridgeshire and Lincolnshire in this country: hence the familiar expression of the waters being overridden is founded in facts continually observed in these districts. We have also the experiments of Brunings in the *Architecture Hydraulique Générale de Wiebeking*, Wattmann's *Mémoires sur l' Art de construire les Canaux*, and Funk *Sur l' Architecture Hydraulique générale*, which are sufficient to determine the coefficient under different circumstances, from velocities of $\frac{2}{5}$ths to $7\frac{1}{2}$ feet, and of transverse sections from [1] to 19135 square feet. The experiments of Dubuat were made on the canal of Jard and the river Hayne; those of Brunings in the Rhine, the Waal and Ifrel; and those of Wattmann in the drains near Cuxhaven.

M. Eytelwein's paper contains formulæ for the contraction of fluid veins through orifices †, and the resistances of fluids passing through pipes and beds of canals and rivers; according to the experiments of Couplet, Michelotti, Bossut, Venturi, Dubuat, Wattmann, Brunings, Funk, and Bidone.

In the ninth chapter of the *Handbuch*, the author has endeavoured

* *Experiences sur le Cours des Fleuves, ou Lettre à un Magistrat Hollandais*, par M. Genneté. Paris, 1760.

† "Recherches sur le Mouvement de l'Eau, en ayant egard à la Contraction qui a lieu au Passage par divers Orifices, et à la Resistance qui retard le Mouvement, le long des Parois des Vases; Par M. Eytelwein."—*Mémoires de l' Académie de Berlin*, 1814 and 1815.

to simplify, nearly in the same manner as the motion of rivers the theory of the motion of water in pipes, observing that the head of water may be divided into two parts, one to produce velocity, the other to overcome the friction; and that the height must be as the length and circumference of the section of the pipe directly, or as the diameter,—and inversely as the area of the section, or as the square of the diameter.

In the allowance for flexure, the product of its square, multiplied by the sum of the sines of the several angles of inflection, and then by ·0038, will give the degree of pressure employed in overcoming the resistance occasioned by the angles; and deducting this height from the height corresponding to the velocity, will give the corrected velocity.*

M. Eytelwein investigates, both theoretically and experimentally, the discharge of water by compound pipes,—the motions of jets, and their impulses against plane and oblique surfaces, as in water-wheels, in which it is shown that the hydraulic pressure must be twice the weight of the generating column, as deduced from the experiments of Bossut and Langsdorft; and in the case of oblique surfaces, the effect is stated to vary as the square of the sine of the angle of incidence; but for motions in open water about $\frac{4}{5}$ths of the difference of the sine from the radius must be added to this square.

The author is evidently wrong in calculating upon impulse as forming part of the motion of overshot wheels; but his theory, that the perimeter of a water-wheel should move with half the velocity of a

* Hence, if f denote the height due to the friction,
$d =$ the diameter of the pipe,
$a =$ a constant quantity,
we shall have, $f = V^2 \frac{a\,l}{d}$ and $V^2 = \frac{f\,d}{a\,l}$.

But the height employed in overcoming the friction corresponds to the difference between the actual velocity and the actual height, that is, $f = h - \frac{V^2}{b^2}$, where b is the coefficient for finding the velocity from the height.

Hence we have, $V^2 = \frac{b^2\,d\,h - d\,V^2}{a\,b^2\,l}$ and $V = \sqrt{\frac{b^2\,d\,h}{a\,b^2\,l + d}}$.

Now Dubuat found b to be 6·6, and $a\,b^2$ was found to be 0·0211, particularly when the velocity is between six and twenty-four inches per second. Hence we have, $V^2 = \frac{43{\cdot}6\,d\,h}{0{\cdot}0211\,l + d}$, or $V = 45{\cdot}5\sqrt{\left(\frac{d\,h}{l + 47\,d}\right)}$,

or more accurately, $V = 50\sqrt{\left(\frac{d\,h}{l + 50\,d}\right)}$.

given stream to produce a maximum effect, agrees perfectly with the experiments of Smeaton and others.*

The author concludes his highly interesting work by examining the effects of air as far as they relate to hydraulic machines, including its impulse against plane surfaces on syphons and pumps of different descriptions, horizontal and inclined helices, bucket-wheels, throwing-wheels, and, lastly, on instruments for measuring the velocity of streams of water. A very detailed account of the work was given in the *Journal of the Royal Institution*, by the late Dr. Young. But it is due to M. M. Dubuat and Prony to state, that M. Eytelwein has exactly followed the steps of these gentleman in his *Theory of the Motion of Water in open Channels.*

In the year 1809 a valuable series of experiments upon the motions of waters through pipes, was made by M. M. Mallet and Vici at Rome, and afterwards by M. Prony.†

It had been proved, by experiments made with great care, that the diminution of velocity, and consequent expenditure in pipes, was not in the ratio of the capacity of the pipes, as Frontinus had supposed in his valuation of the product of the ancient module or calice; and as it was desirable to ascertain the actual product of the three fountains now used at Rome, a series of experiments was undertaken by these gentlemen; the principal result of which was, that a pipe, of which the gauge was 5 onces‡, furnished $\frac{1}{7}$th more water than 5 pipes of one once, on account of the diminution of the velocity by friction in the ratio of the perimeters of the orifices as compared with their areas.

M. Mallet also made a great many researches relative to the distribution of water in the different cities and towns of England and France, with a view to their application at Paris; of all of which he has published an account.

The researches that had been made hitherto on the expenditure of water through orifices, had for their object the determination of the velocity and magnitude of the section, by which it is necessary to multiply the velocity to obtain the expense. But although these be the first elements for consideration, they are not sufficient; for the

† The author of this paper has made a great many experiments on the maximum effect of water-wheels; but the recent experiments of the Franklin Institution, made on a more magnificent scale, and now in the course of trial, eclipse every thing that has yet been effected on this subject. See also Poncelet, *Mémoire sur les Roues Hydrauliques*, and *Aubes Courbes par dessous, &c.* 1827.

† *Notices Historiques*, par M. Mallet. Paris, 1830.

‡ French measure, or 0·03059 French kilolitres.

fluid vein presents other phænomena equally important, both in the theory and its application, namely, the form and direction of the vein after it has issued from the orifice. The former phænomena, as we before stated, had been long noticed by Michelotti and others, but nothing precise had been established on the forms and remarkable phænomena of the fluid vein itself. Venturi had given three examples.

M. Hachette, in two memoirs presented to the Académie Royale des Sciences in 1815 and 1816, also considered the form of veins; and in his *Traité des Machines*, he states that he had already given a description of veins issuing from circular, elliptical, triangular, and square orifices, without having entered into any detail respecting them, so that that part of the subject was in a great measure involved in doubt. In 1829 a paper, entitled "Expériences sur la Forme et sur la Direction des Veines et des Courans d' Eau, lancés par diverses Ouvertures," was read to the Academy of Sciences at Turin by M. Bidone, giving an account of a series of experiments made in the years 1826 and 1827, in the Hydraulic Establishment of the Royal University. The results of these experiments are divided into five articles. The first gives a description of the apparatus and mode of proceeding, and the figures obtained from veins expended from rectilinear and curvilinear orifices, with salient angles pierced in vertical plates, and whose perimeters are formed by straight and curved lines, varying upwards of 50 different ways, with variable and invariable changes, from zero to 22 French feet: the area of water was equal to one square inch. The sections of the veins were taken at different distances from the aperture. The results are extremely curious, as illustrating the influence of pressure and divergence on part of a fluid mass not *in equilibrio*, and may be assimilated to the phænomena presented by the undulation of streams of light. The author contents himself with stating the results, which are further illustrated by diagrams.

In a second paper, read to the Accademia delle Scienze in April following of the same year (1829), M. Bidone enters into a theoretical consideration of his experiments, in which he represents the greatest contraction of the fluid vein to take place at a distance not exceeding the greatest diameter of the orifice, whatever be the shape; from which it results that the expression for the expense of the orifice is equal to the sum of the product of each superficial element multiplied by the velocity of the fluid vein; and it was determined by experiment that the area of the vena contracta was from 0·60 to 0·62 of the area of the orifice, it follows that this coefficient of contraction, multiplied by the velocity due to the charge, represents the expenditure.

M. Bidone considers the case of a fluid vein reduced to a state of permanence, and expended from a very small orifice, as compared

with the sections of the containing vessel, according to the theory of Euler; and finds that the magnitude of the section of the contracted vein does not depend upon the velocity of the component filaments, but solely on their direction, a result conformable to experiment.

He then determines, from the results of M. Venturoli*, the absolute magnitude of the contracted section of the vein (issuing from a circular orifice) to be exactly ⅔rds of the orifice, the correction due to the contraction depending upon the adhesion and friction of the fluid against the perimeter of the orifice, and the ratio of the area of the vein to the area of the orifice: the same for all orifices. Hitherto the magnitude of fluid veins, as determined by direct measurements, had given greater coefficients than the effective expenditure allowed.

Michelotti, with a pressure of 20 feet, with orifices of one and two inches in diameter, found the coefficient .... 0·649

Bossut	0·660
Borda	0·646
Venturi	0·640
Eytelwein	0·640
Hachette	0·690
Newton	0·707
Helsham	0·705
Brindley and Smeaton	0·631
Banks	0·750
Rennie†	0·621

In several experiments the ratio rarely exceeded 0·620, so that the discrepancy must have arisen from inaccuracies in the measurement of the fluid vein and orifice.

In the year 1827, it having been considered desirable to repeat the experiments of Bossut and Dubuat, application was made to the French Government by General Sabatier, Commander-in-chief of the Military School at Metz, for permission to undertake a series of experiments on a scale of magnitude sufficient to establish the principles laid down by those authors, and serve as valuable practical rules for future calculations. The apparatus consisted, 1st, of an immense basin, having an area of 25,000 square metres; 2nd, of a smaller reservoir, having a superficial area of 1500 square metres, and a depth of 3·70 metres, so contrived, by means of sluices, as to have a com-

* *Elementi di Meccanica e d' Idraulica:* Milano, 1818. *Recherche Geometriche fatte nella Scuola degli Ingegneri Pontifici d' Acque e Strade, l' anno* 1821. Milano.

† "On the Friction and Resistance of Fluids," Philosophical Transactions of 1831.

plete command of the level of the water during the experiment; 3rd, of a basin directly communicating with the second basin, 3·68 metres in length, and three metres in width, to receive the product of the orifices; 4th, a basin or guage capable of containing 24,000 litres.

The time was constantly noticed by an excellent stop-watch, made by Breguet; and the opening of the orifices, the charges of the fluid in the reservoir, as well as the level of the water in the gauge basin relative to each expense of fluid, were always measured to the tenth of a millimetre, so that, even under the most unfavourable circumstances, the approximation was at least to $\frac{1}{200}$dth part of the total result. The total disposable fall or height, counting from the ordinary surface of the Mosselle river, was four metres, from which two metres were deducted for the gauge basin, leaving only a fall of 2 metres under the most favourable circumstances; and in the subsequent experiments of 1828 the height never exceeded 1·60 metre, sufficiently high for all practical purposes. An apparatus was provided for regulating the height of the orifice and the surface of the water in the reservoirs, and for tracing with the greatest accuracy the forms and sections of the fluid veins before and after issuing from the orifices, and the depressions experienced by the surface of the water previously to its issuing from an opening of 20 centimetres square, the upper side of which was on a level with the surface of the water in the reservoir. These depressions are recorded in the Tables.

1st, On the expenditure of water through rectangular vertical orifices, 20 centimetres square, and varying in height from 1 to 20 centimetres, under charges of from ·0174 of a metre to 1·6901 metre:

2ndly, On the expenditures of water from the similar sized orifices, open at the top, but under charges of from 2 to 22 centimetres.

The whole is comprised in 11 Tables of 241 experiments, to which is added a twelfth Table, showing the value of the coefficients of contraction for complete orifices, from 20 centimetres square to 1 centimetre, calculated according to the following formula:

D for the height of the orifices, where *

$D = l\,o\,\sqrt{2\,g\,h} = l\,(h - h')\,\sqrt{2\,g\frac{(h + h')}{2}}$ being the theoretical expense relative to the velocity;

* That is, where $l = 0{\cdot}20$ metre, being the horizontal breadth of all the orifices;
h = the charge of the fluid on the lower part of the orifice;
h' = the charge in the upper or variable side of the orifice;
$o = h - h'$ the thickness of the vein of water.

$D' = \frac{2}{3} l o \sqrt{2 g} \left(h^{\frac{3}{2}} - h'^{\frac{3}{2}}\right) = \frac{2}{3} l \left(h \sqrt{2 g h} - h' \sqrt{2 g h'}\right)$ or the theoretical expense, having regard to the influence of the orifice.

The conclusions to be derived from these Tables are,

1st, That for complete orifices of 20 centimetres square and high charges, the coefficient is 0·600; with the charge equal to 4 or 5 times the opening of the orifice, the coefficient augments to 0·605; but beyond that charge the coefficient diminishes to 0·593.

2ndly, That the same law maintains for orifices of 10 and five centimetres in height, the coefficients being for 10 centimetres 0·611, 0·618, 0·611, respectively, and for 5 centimetres in height 0·618, 0·631, 0·623.

Lastly, That with orifices of 3, 2, and 1 centimetres in height, the law changes very rapidly, and the coefficients increase as the opening of the orifice becomes less, being for 1 centimetre 0·698, the smallest height of the orifice, to 0·640 for three centimetres.

These remarkable discrepancies from the results of Bidone and others are attributed by MM. Lesbros and Poncelet to differences in the construction of the apparatus or in the mode of measurement adopted by the latter gentlemen; but in general the coincidences are sufficiently satisfactory, and they are the more accurately confirmed by the subsequent investigations of MM. D'Aubuisson and Castel at Toulouse.* As respects water issuing from the openings or notches made in the sides of dams, or what we should term *incomplete* orifices, it appears that the coefficient obtained by the ordinary formula of Dubuat, or $l h \sqrt{2 g h}$, augments from the total charge of 22 centimetres when it is from 0·389 to 2 centimetres when it becomes 0·415; we may safely adopt M. Bidone's coefficient of 0·405, or, according to MM. Poncelet and Lesbros' theory 0·400, for calculating expenditures through notches in dams. From these and other experiments the authors are led to conclude, that the law of continuity maintains for indefinite heights both with complete and *incomplete* orifices, and that the same coefficient can be obtained by adopting in both cases the same formula. The authors observe that the area of the section of the greatest contraction of the vein, considered as a true square, is exactly two-thirds of the area of the orifice; a fact which goes to prove that there is no certain comparison between the mean theoretical or calculated velocities, by means of the formula now used, and the mean effective velocities derived from the expenditure.

The authors conclude their memoir by recommending their experiments for adoption in all cases of plate orifices situated at a distance

* *Annales de Chimie et de Physique* for 1830, tom. xliv. p. 225.

from the sides and bottom of the reservoir, promising to investigate with similar accuracy in a future memoir the cases which may occur to the contrary.

A note is appended to the memoir by M. Lesbros containing formulæ for calculating the effective expenditure of complete orifices; and also a Table of constants, which gives the effective expenditure of each orifice as compared with experiment. We have been thus particular in detailing the results of MM. Lesbros and Poncelet's work, because they have comprehended all the cases upon which there remained any doubts, and with very few exceptions are in accordance with the experiments of Brunacci, Navier, Christian, Gueymard, D' Aubuisson, and by the author of this paper.* So that in point of accuracy and laborious investigation, the authors of these valuable accessions to our knowledge, not only merit our gratitude, but have very amply replied to the liberality of the French government.

Having thus endeavoured to elucidate the labours of the foreign philosophers who have contributed so greatly to the progress of hydraulics, it only remains for us to notice the scanty contributions of our countrymen to the science. While France and Germany were rapidly advancing upon the traces of Italy, England remained an inactive spectator of their progress, contented with the splendour of her own Newton, to receive from foreigners whatever was original or valuable in the science. The *Philosophical Transactions*, rich as they are in other respects, scarcely contain a single paper on this subject founded on any experimental investigations. Some erroneous and inconclusive inferences from Newton, by Dr. Jarin; a paper on the Measure of Force, by Mr. Eames; a paper on Wiers, by Mr. Roberts; another on the Motion and Resistance of Fluids, by Dr. Vince; and a summary of Bossut and Dubuat's Experiments on the Motions of Fluids through tubes, by Dr. Thomas Young, comprise nearly the whole of the papers on hydraulics in the *Philosophical Transactions*. The various treatises on the subject published by Maclaurin, Emerson, Dr. Matthew Young, Desaguliers, Clare, and Switzer, with the exception of the theoretical investigations, are compiled principally from the works of foreigners; and it was not until the subject was taken up by Brindley, Smeaton, Robinson, Banks, and Dr. Thomas Young, that we were at all aware of our deficiency. Practical men were either necessitated to follow the uncertain rules derived from their predecessors, or their own experience and sagacity, for the little knowledge they possessed.

On the subject of hydrometry we were equally ignorant; and although the Italian collection had been published several years

* *Philosophical Transactions* for 1831.

previously, and was well known on the Continent, it was not until Mr. Mann published an abstract of that collection that we were at all aware of the state of the science abroad.

Under these circumstances the author of this paper was induced, in the year 1830, to undertake a series of experiments to ascertain, 1st, The friction of water against the surface of a cylinder, and discs revolving in it, at different depths and velocities: from which it appeared, that with slow velocities the friction approximated the ratio of the surfaces, but that an increase of surface did not materially affect it with increased velocities; and that with equal surfaces the resistances approximated to the squares of the velocities,

2ndly, To ascertain the direct resistances against globes and discs revolving in air and water alternately: from which it resulted, that the resistances in both cases were as the squares of the velocities; and that the mean resistances of circular discs, square plates, and globes of equal area, in atmospherical air, were as under:

Circular discs	25·180..............	1·18
Square plates	22·010 in air,.........	1·36 in water
Round globes..... ..	10·627..............	0·75

3rdly, That with circular orifices made in brass plates of $\frac{1}{60}$th of an inch in thickness, and having apertures of $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{1}{1}$ of an inch respectively, under pressures varying from one to four feet, the average coefficients of contraction were,

for altitudes of 1 foot.......... ....0·619
4 feet...........................0.621

For additional tubes of glass the coefficient was,

for 1 foot............................0·817
4 feet .. .. 0·806

4thly, That the expenditures through orifices, additional tubes, and pipes of different lengths, of equal areas and under the same altitude as compared with the expenditure through a pipe of 30 feet in length, are as

1 : 3 for orifices,
1 : 4 for additional tubes,
1 : 3·7 for a pipe 1 foot in length,
1 : 2·6 ——— 8 feet ———,
1 : 2·0 ——— 4 ———,
1 : 1·4 ——— 2 ———,

5thly, That with bent rectangular pipes ½ an inch in diameter, and 15 feet in length, the expenditures were diminished with 14 bends, two-thirds, as compared with a straight pipe and with 24 right angles, one-third, but did not seem to observe any decided law.

In several experiments tried on a great scale, the results gave from

one-fifth to one-sixth of the altitude for the friction. In the case of the Coniston main, which conducts the water from the reservoir at Coniston to the castle of Edinburgh, the diameter of which is 4½ inches, the length 14,930 feet, and the altitude 51 feet; it was proved by Mr. Jardine, that the formulæ of Dubuat and Eytelwein approximated to the real results very nearly; and in some experiments made on a great scale by the author of this paper, these formulæ were found equally applicable. In several experiments made in the year 1828, on the water-works at Grenoble by M. Gueynard, it was found that pipes of 6 and 8 French inches in diameter furnished only two-thirds of the water indicated by the formulæ of M. Prony: but when of 9 inches diameter, the formula approximated very nearly. In M. Gueynard's experiment the altitude of the reservoir above the point of delivery was 8·453 metres, or 27·73 English feet. The height to which the water was required to be elevated was 5·514 metres, or 18 feet; the volume of water required was 954 litres, or 33·6 cubic feet; the length of the pipe was 3200 metres, or 10,498 feet. There were eight gentle curves in the system, but enlarged beyond the average diameter of the parts of the pipe; from which it resulted that the height to which the water was delivered was only ⅔rds of the height of the reservoir.*

In the preceding short but imperfect history of the science of hydraulics we have confined our attention to the experimental researches that have been made on spouting fluids only. In a future communication I hope to examine the state of our knowledge of the natural phœnomena of rivers, and the causes by which they are influenced; at present it is extremely limited, and although we have many works upon the subject, very little seems to be known either of their properties or of the laws by which they are governed.

APPENDIX.

Since the foregoing Report was read to the British Association, a paper, entitled "Mémoire sur la Constitution des Veines Liquides lancées par des Orifices Circulaires en mince paroi," has been communicated to the Academy of Sciences at Paris, by M. Félix Savart, 26

* According to M. Prony's theory, the height raised would only have been 5·514 metres instead of 5·671 metres. The difficulty, however, of making experiments on a great scale will always prove an obstacle to the right solution of the question, inasmuch as it exacts that the pipe be of the same diameter throughout that is, perfectly straight, and free from bends, and the change of water invariable. For this purpose, M. Prony has calculated Tables, shewing the relation subsisting between the expenditure, diameter, length, the total inclination of the pipes, and the difference of pressure at its extremities.

Août, 1833. The author, after detailing very minutely the different phœnomena presented by liquid veins issuing from circular orifices perforated in thin plates attached to the bottom and sides of vessels, illustrates his positions by a series of curious experiments on the vibrations and sounds of the drops which issue from the annular rings or pipes formed by the troubled part of the liquid. The results of these experiments are best given in his own words.

"1°. Toute veine liquide lancée verticalement de haut en bas par un orifice circulaire pratiqué dans une paroi plane et horizontale est toujours composée de deux parties bien distinctes par l'aspect et la constitution. La partie qui touche à l'orifice est un solide de révolution dont toutes les sections horizontales vont en décroissant graduellement de diamètre. Cette première partie de la veine est calme et transparente, et ressemble à un tige de cristal. La seconde partie, au contraire, est toujours agitée, et parait dénuée de transparence, quoiqu'elle soit cependant d'une forme assez régulière pour qu'on puisse facilement voir qu'elle est divisée en un certain nombre de renflemens allongés dont le diamètre maximum est toujours plus grand que celue de l'orifice.

"2°. Cette seconde partie de la veine est composée de gouttes bien distinctes les unes des autres, qui subsissent pendant leur chute, des changemens périodiques de forme, auxquels sont dues les apparences de ventres ou renflemens régulièrement espacés que l'inspection directe fait reconnaître dans cette partie de la veine, dont la continuité apparente dépend de ce que les gouttes se succèdent à des intervalles de temps qui sont moindres que la durée de la sensation produite sur la rétine par chaque goutte en particulier.

"3°. Les gouttes qui forment la partie trouble de la veine sont produites par des renflemens annulaires qui prennent naissance très près de l'orifice, et qui se propagent à des intervalles de temps égaux, le long de la partie limpide de la veine, en augmentant de volume à mesure qu'ils descendent, et qui enfin se séparent de l'extrémité inférieure de la partie limpide et continue à des intervalles de temps égaux à ceux de leur production et de leur propagation.

"4°. Ces renflemens annulaires sont engendrés par une succession pèriodique de pulsations qui out lieu à l'orifice même; de sorte que la vitesse de l' écoulement, au lieu d'être uniforme, est périodiquement variable.

"5°. Le nombre de ces pulsations, même pour des charges foibles, est toujours assez grand, dans un temps donné, pour qu'elles soient de l'ordre de celles qui, par la fréquence de leur retour, peuvent donner lieu à des sons perceptibles et comparables. Ce nombre ne dépend que de la vitesse de l' écoulement, à laquelle il est directement proportionnel, et du diamètre des orifices, auquel il est inversement

proportionnel. Il ne paraît altéré ni par la nature du liquide, ni par la température.

"6°. L'amplitude de ces pulsations peut être considérablement augmentée par des vibrations de même période communiquées à la masse entière du liquide et aux parois du réservoir qui le contient. Sous cette influence étrangère, les dimensions et l'état de la veine peuvent subir des changemens remarquables: la longueur de la partie limpide et continue peut se réduire presqu'à rien, tandis que les ventres de la partie trouble acquièrent une régularité de forme et une transparence qu'ils ne possèdent pas ordinairement. Lorsque le nombre des vibrations communiquées est différent de celui des pulsations qui ont lieu à l'orifice, leur influence peut même aller jusqu' à changer le nombre de ces pulsations, mais seulement entre de certaines limites.

"7°. La dépense ne paraît pas altérée par l'amplitude des pulsations, ni même par leur nerubre.

"8°. La resistance de l'air n'influe pas sensiblement sur la forme et les dimensions des veines, non plus que sur le nombre des pulsations.

"9°. La constitution des veines lancées horizontalement ou même obliquement de bas en haut ne différe pas essentiellement de celle des veines lancées verticalement de haut en bas; seulement le nombre des pulsations à l'orifice paraît devenir d' autant moindre que le jet approche plus d'être lancé verticalement de bas en haut.

"10°. Quelle que soit la direction de la veine, son diamètre décroît toujours très rapidement jusqu'à une petite distance de l'orifice; mais quand la veine tombe verticalement, le décroissement continue jusqu'à ce que la partie limpide se perde dans la partie trouble: il en est encore de même quand la veine est lancée horizontalement, quoiqu'alors le décroissement suive une loi moins rapide. Lorsque le jet est lancé obliquement de bas en haut, et qu'il forme avec l'horizon un angle de 25° à 45°, toutes les sections normales à la courbe qu'il décrit deviennent sensiblement égales entre elles, à partir de la partie contractée que touche à l'orifice. Enfin, pour des angles plus grands que 45°, le diamètre de la veine va en augmentant depuis la partie contractée jusqu'à la naissance de la portion trouble; de sorte que c'est seulement alors qu'il existe une section qu'on peut a juste titre appeler section contractée."

A. T.

FOURTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—This meeting was held at Edinburgh, and commenced its business on Monday, Sept. 8th. Sir Thos. Brisbane

was the president; Sir David Brewster and the Rev. Dr. Robinson, Astronomer Royal of Armagh, vice-presidents; and J. Robison, sec. R.S.E., and Professor Forbes, acted as secretaries. The business was divided into the following sections:—1. Mathematics and Physics; Professor Whewell, of Cambridge, and Dr. Lloyd, Provost of Trinity College, Dublin, chairmen. 2. Chemistry and Mineralogy; Professor Hope, chairman. 3. Geography and Geology; Professor Jamieson, chairman. 4. Anatomy and Medicine; Dr. Abercrombie, chairman. 5. Zoology and Botany; Professor Graham, chairman. 6. Statistics (a new feature in the Association's proceedings); Sir C. Lemon and Col. Sykes, chairmen. Three hundred and fifty members dined together on the Monday, Professor Sedgwick in the chair; and after the dinner the meeting was formally commenced in the Assembly Rooms, which were placed at the disposal of the Association. At a little after eight the chair was taken by Sir Thomas Brisbane. The great and unexpected accession of new members greatly disconcerted the arrangements, which had been previously made, and which are stated to have been excellent: the number is now 2200, at the last meeting at Cambridge it was 1400.

In the section of *Mathematics and Physics*, Professor Whewell read the report of Mr. Challis on the theory of capillary attraction: also a paper from Mr. Challis, containing theoretical explanations of some facts relating to the composition of the colours of the spectrum. Professor Powell read a paper on the repulsion produced by heat as established by the contraction of Newton's rings, when heat is applied to the glasses: also on the achromatism of the eye; and renewed the subject of the undulatory theory of light, which was discussed at considerable length. Professor Lloyd read a portion of his report on physical optics; and gave an account of magnetical observations undertaken in Ireland at the request of the Association, and of a new method of observation which he has employed. Professor Phillips made his second report of the result of twelvemonths experiments on the quantity of rain falling at different elevations above the ground; and communicated a paper on a new form of the dipping needle, constructed so as to correct the error of the centre of gravity. Professor Stevelly read a paper entitled, An attempt to connect some well-known phenomena in meteorology with well-established physical principles; in which the following questions were discussed: 1. The nature, origin, and suspension of clouds, and the immediate effect of their formation. 2. The manner in which rain is produced, and the immediate effect of its production. 3. The manner in which wind results from the formation of cloud and rain. And, 4. The origin of hail. The Professor also made some valuable observations on

capillary phenomena. Mr. Rennie presented the second part of his report on Hydraulics.* Professor Hamilton gave an account of a new method in Dynamics, and explained a new method of contriving imaginary quantities, and the principles of a theory which he denominated the "Theory of Conjugate Functions." Dr. Knight gave an account of the method of rendering the vibrations of heated bodies visible to the eye. Mr. Russell read a very able account of some experiments on the traction of boats on canals at great velocities. Sir D. Brewster detailed the result of some experiments on the effects of reflexion from the surfaces of Crystals that had been altered by solution. Mr. Graves presented a paper on the theory of exponential functions. Mr. Lang stated the results of some investigations which he had made on the nature of the curves described by vibratory wires fixed at one end; and also noticed some properties of the successive integer numbers, tending to facilitate the discovery of those that are prime. Dr. Williams read a paper on sound. Dr. Robinson read a paper on the visibility of the moon during a total eclipse. And Mr. Adie a very interesting one on the expansion of stone. Several instruments of new and peculiar construction were also exhibited and explained.

In the section of *Chemistry and Mineralogy*, a discussion took place on certain experiments made by Dr. Daubeny on thermal waters, and the gases they evolve. Dr. Daubeny read a paper on the relative heating powers of coal tar, and splint coal. A paper of Dr. C. Williams was read, on a new law of combustion. A paper was also read relative to the destructive distillation of organic substances. A discussion on chemical notation was introduced by Mr. Johnston; and the subject was referred to the committee, with the view of introducing a uniform system of chemical notation. The Rev. Mr. Harcourt, secretary to the institution, and almost its founder, detailed some experiments of his, now in progress, on the effects of long continued heat on certain bodies, and of the disposition of them under the iron furnaces in Yorkshire. Professor Clerk read a paper on the use of hot air in the smelting of cast iron, and gave some numerical results of the advantage of the new process. Dr. Christison read a paper on the action of water on lead; Dr. Graham one on the constitution of certain hydrated salts; and Mr. Kemp one on the liquefaction on gases. And a communication was made by Professor Stevelly, on applying a vernier to a scale, not of equal, but of variable parts; and particularly to the scale of Wollaston's Chemical Equivalents.

In the section of *Geology and Geography*, in addition to some

* The first part of this Report will be found in the *Repertory*, vol. ii. (New Series) pp. 166, 218.

valuable information contained in the communications, a very animated discussion arose on the subject of primary formations. Mr. Stevenson's report as to the change in the relative level of land and water, was read. Several geological papers were read, particularly one by Lord Greenock, on the coal formation and strata of Scotland. Mr. Nicol read a paper on the subject of the structure of fossil wood. Professor Traill read a paper on the fossil remains found in Orkney, and he subsequently announced that the fossil fishes which he had brought from thence had been inspected by M. Agassiz, who had discovered among them five new species. Mr. J. Bryce read a notice of some bones found in a cavern near the giant's causeway; a paper was also read on the geology of the Pentland hills. Mr. Murchison read a paper on the fossil fishes found in the old red sand stones of England, and also in Forfarshire and other counties in Scotland. And M. Agassiz gave an account of certain fossils found in the quarries near Burdiehouse; which he conceived at first to be reptiles; but which were in reality fishes of the character of reptiles. Several other important communications were made to this section.

In the section of *Anatomy and Medicine* there was nothing of a popular nature, except Sir C. Bell's lecture on the nervous system.

In the section of *Zoology and Botany* a report was read by Mr. Jennings on the recent progress and present state of zoology. A paper was read by Professor Hooker, giving an account of an excursion in Quito and Chimborazo, along with Capt. Hall, containing allusions to the state of vegetation in that neighbourhood. Mr. Selby read a lengthened notice of the birds obtained during an excurison in Sutherlandshire; and on the structure and use of orbital glands. Sir W. Jardine also read a paper on the various species of the genus Salmo, collected during the same tour, exhibiting the specimens and drawings. Mr. Trevelyan read a notice on the distribution of the phenogamous plants of the Faroe Island. A paper was read by Mr. J. G. Dalzell on the propagation of Scottish zoophytes, illustrated by many beautiful drawings. Dr. Arnott read a paper on the coculus indicus of commerce. Mr. Murray made some observations on his success in cultivating Phormium tenax. Dr. Traill made some observations on a new species of thrush found in Brabant. Mr. Pentland concluded his observations on the remains of what appeared to him to be an extinct variety of the human race, which had inhabited a district in South America extending from the 16th to the 29th degree of south latitude. And Sir D. Brewster gave a masterly account of a remarkable structure in the webs of the feathers of birds for keeping the laminæ from separating during flight.

In the section of *Statistics* a paper by Mr. Heywood of Manchester was read as to the means of education provided for the lower classes.

A paper of statistics, by Dr. Clelland, relative to Glasgow, was read. An account was given of the modes in which the statistical survey of Scotland now in progress, was conducted. Capt. Maconochio read a very able analysis of Guerry's "Essai sur la Statistique Morale de la France." And Mr. Auldjo read a paper, "on the Statistics of the Kingdom of Naples."

At the evening meetings lectures were delivered by Dr. Lardner on Babbage's calculating machine; by Professor Buckland on fossil reptiles; and by Professor Whewell on several interesting phenomena connected with the tides.

The following are among the most distinguished of the members and foreign associates already enrolled, selected from the list of members, which has received a large accession of numbers in Edinburgh :

From the Continent—M. Arago, Astronomer Royal, from Paris, Professor Mole, (Utrecht,) Baron Ende, (Baden,) MM. Treviranus, Tiedemann, Jacobson, (Berlin,) Ulman, (Weimar,) Von Drüffel, A. Vander Foorn, M. le Marquis de St. Croix, Le General Dubourg, M. Année, Le Chevalier Jean Audiffredie, Le Chevalier Gregoire Berardi, (Rome,) Mons. Nelly, M. de la Rive, (both of Geneva,) Dr. Vlastos, (Island of Chios).

From America—Dr. Mason Warren, of Boston, Dr. Hooper, Mr. Beriah Botfield.

From Ireland—Rev. Dr. Lloyd, Provost of Trinity College, Dublin, Professor Hamilton, Rev. Dr. Robinson, Sir John Jeffcott, Professor H. Lloyd, Rev. Sidney Smith.

From England and Scotland—Sir Charles Bell, Mr. Charles Babington, (Cambridge,) Rev. T. Churton, Dr. C. Daubeny, Mr. C. Fellows, Rev. W. Garndus, G. B. Greenough, Dr. E. Grove, Professor Knight, Dr. Kelty, Rev. Dr. Lardner, R. I. Murchison, (late President of the London Geological Society,) Professor Phillips, Rev. Dr. Penny, Professor Roget, Professor Trevelyan, H. Woolcombe, (President of the Plymouth Institution,) Sir Alexander Wood, Henry Cockburn, the Solicitor General, Sir George Clerk, Professor Christison, M.D., Dr. Coombe, Professor Chalmers, Lord Dalmeny, Lord Fullerton, Viscount Melville, Hon. Lord Jeffrey, Lord Advocate, Professor Macvey Napier, Professor Pillans, Lord Roseberry, &c. &c.

The next meeting is to be held in Dublin on the 10th of August, 1835. Dr. Lloyd to be President, Lord Oxmanton and Professor Whewell, Vice Presidents, Professors Lloyd and Hamilton, Secretaries. —*Abridged from the Athenæum.*

ORIGINAL AND SELECTED PAPERS.

Biographical Notice of the late Thomas Telford, Esq. and a Glance at some of the great Works of that celebrated Engineer.

TO THE EDITOR, &c.

Sir,

It is peculiarly fitting that your work, which for forty years past has contributed so largely to the diffusion of practical science, being the elder journal of all the scientific periodicals existing in this country, should contain a copious and correct account of the great works of the most extensively practical engineer that Great Britain has produced.

I am therefore sure that you and your readers will be pleased to receive some information, which my long acquaintance with Mr. Telford and many of his friends, enables me to furnish, in addition to that already published in the newspapers and in the weekly scientific and literary journals.

Mr. Telford departed this life on the 2nd of the present month (Sept. 1834), after a short attack of a bilious nature.

His remains were deposited in Westminster Abbey on the 10th instant; the funeral was conducted in the most unostentatious manner, but followed by about 60 of his personal friends, among whom were Sir Henry Parnell, Bart, Capt. Beaufort, Mr. Milne, commissioner of woods and forests, and the vice presidents and council of the Institution of Civil Engineers, over which he so ably presided during many years, and by the constancy and punctuality of his attendance, and the uniform urbanity of his manners, won the warm attachment of the members and associates.

It is suggested that the most appropriate monument to

be placed over his tomb would be, a huge granite block, polished, and inscribed "*Thomas Telford.*"

An account of some of Mr. Telford's public works is published in the Imperial Magazine for July 1832, (second series, No. 19, vol. 2, page 297,) accompanied by a good engraving, but the likeness is spoiled by a too great perpendicular length of the nose. I have made something near a likeness of Mr. Telford's appearance 20 years ago, by cutting out, with a sharp knife, from one of the impressions, a parallel and horizontal strip, one twenty-fourth part of an inch wide, all across the paper, immediately above the swelling of the right nostril, and bringing the two cut edges of the paper in contact, and gumming them down upon a piece of pasteboard.

But the excellent likeness now exhibited in many of the print shop windows of London, engraved by Mr. Raddon, and published by him and Mr. Turreel of Somers Town, from a painting by Mr. Lane, in possession of the Institution of Civil Engineers, brings Mr. Telford home to the remembrance of his friends, and may afford to those who have never seen him, but who can read the human countenance, a fine picture of his open, straightforward, and manly firmness of character.—Dr. James Cleland, in his enumeration of the inhabitants of Glasgow and county of Lanark for the government census of 1831, published in 1832, gives the following account of Mr. Telford and his works, an account which may be depended on from the great intimacy of the parties.

"*Mr. Thomas Telford, Civil Engineer, F.R.S. L. & E. President of the Society of Civil Engineers, London, &c. &c.*

"In a work of this kind, where men distinguished for scientific attainments are made honourable mention of, it would be reprehensible in the highest degree, to omit a civil engineer who stands unequalled in this, or probably in any other country, for the number and importance of his public works, for the estimation in which he is held

at home and abroad, and for the uninterrupted length of time in which he has successfully laboured in the public service. Scotland, while enumerating her sons, may be justly proud of such a man.

"Mr. Telford was born in the parish of Westerkirk, in the county of Dumfries, in the year 1757, and was educated at the parish school. At the age of fourteen, he was apprenticed to the trade of a mason, and employed in building a house at Ramerskales in Annandale, for Dr. Mountjoy, who had returned from being first physician to the court of Petersburg.

"Mr. Telford continued to be so employed in house and bridge building, in his native district of Eskdale, until 1783, when, having been taught architectural drawing at Edinburgh, he proceeded to London, and was for some time employed at the great square of public offices at Somerset house. He afterwards superintended public buildings at Portsmouth dock-yard, previous to acting generally as an architect and engineer.

"The following is a note of the principal works conducted by the projector and executor of the Menai bridge, a work seldom equalled in magnitude :—

"1788. Shrewsbury Castle converted into a dwelling house.

"New gaol built for the county of Salop.

"Twenty-six bridges in the same county, from 20 to 130 feet span; two of these over the river Severn.

"1798. A bridge over the river Severn, at the town of Bewdley, consisting of three arches.

"A bridge, 112 feet span, over the river Dee, at Kirkcudbright, in Scotland.

"Bridgenorth church, (see the Edinburgh Encyclopædia.)

"The Ellesmere canal, commenced in 1790. Length, 103 miles. Chief works, Pont of Cysyltn Aqueduct, one thousand feet long, and one hundred and twenty eight feet high; Chirk Aqueduct six hundred feet long, and seventy feet high.

"Highland roads and bridges, commenced in 1803. Under this commission were built one thousand one hundred and seventeen bridges in the Highlands.

"The Caledonian canal, begun in 1804. Locks, each 180 feet long, 40 wide, depth of water, 20 feet.

"Dunkeld bridge, finished in 1809. Nine arches, centre one 90 feet span.

"The Glasgow, Paisley, and Ardrossan canal.

"Aberdeen harbour. Extension and improvements, commenced in 1810.

"Dundee harbour. Extension and improvements, commenced in 1815.

"Dundee Ferry Piers on both sides of the river, in 1822.

"The Glasgow and Carlisle road, commenced in 1816, upon which were built 23 bridges of 150, 90, 80, 60, 50 feet span and under.

"The Lanarkshire roads, including bridge at Cartland Craigs, 123 feet high; and four other large bridges.

"Increasing the width of the roadway over Glasgow old bridge with cast-iron.

"The Dean bridge over Leith Water, at Edinburgh, four arches, each 90 feet span. Roadway above the river 108 feet.

"Pathhead bridge, 11 miles from Edinburgh, on the Dalkeith road, five arches, 70 feet high.

"Morpeth bridge, Northumberland, consisting of three arches.

"The Holyhead road from London to Dublin, including the Menai and Conway bridges.

"Improving the river Weever navigation, between the Cheshire salt works and sea entrance.

"Constructing a tunnel 3000 yards in length, through Harecastle hill, upon the Trent and Mersey navigation, near the great Staffordshire potteries.

"Making a canal from ditto, 29 miles in length, by Macclesfield, to the Peak forest and Huddersfield canals.

"Improving the Birmingham old canal, formerly laid out by Mr. Brindley.

"Making a canal 39 miles in length, with a branch 11 miles, to connect the Birmingham canal with the Shropshire and Cheshire canals, and open a new communication with Liverpool and Manchester, and thence to London.

"Improving the outfalls of the river Ouse, in Norfolk, and the Nene in Lincolnshire, including the drainage of the North Bedford Level, between the Nene and the Welland.

"Constructing the St. Katherine Docks, adjoining Tower Hill, London.

"Constructing a cast-iron bridge, 170 feet span, over the river Severn, at Tewksbury, in Gloucestershire.

"Building a stone bridge, 150 feet, over the Severn, near the city of Gloucester.

"Designing a stone bridge of seven arches, 50 feet wide within the parapets, and 500 feet long, about to be built over the Clyde, at Glasgow, on the site of Jamaica Street bridge.

"Opening a navigable communication across Sweden, from Gothenburg, on the North Sea, to Soderking, on the Baltic.

"In the year 1817, parliamentary loan commissioners were appointed to apply 1,750,000*l*. towards carrying on public works. Mr. Telford was employed as their engineer; and since that time he has examined and reported on the following works, for which aid was requested.

"1. The regent's canal, from Paddington, by Islington, to Limehouse.

"2. A cast-iron bridge across the Thames from Queen Street.

"3. A short canal between the Thames and Isis, and the Wilts and Berks canal.

"4. For an extension of Folkstone Harbour, on the coast of Kent.

"5. For completing the Thames and Medway canal, from Gravesend to Rochester.

"6. For completing the Gloucester and Berkley canal, which was done under his direction.

"7. For completing the Portsmouth and Arundel canal.

"8. For the Tay ferry piers, which were constructed under his direction.

"9. For rebuilding Folly bridge, at Oxford, on the site of Friar Bacon's study.

"10. For making a short canal between the river Lea and the regent's canal.

"11. For rebuilding Windsor and Kingston bridges upon the river Thames.

"12. For making a canal from the city of Exeter to the sea.

"13. For constructing a harbour at Shoreham, on the coast of Sussex.

"14. For building a timber bridge at Teignmouth, in the county of Devon.

"15. For completing the Bridgewater and Taunton canal.

"16. For constructing locks and wears upon the river Thames.

"17. For completing the Liverpool and Manchester railway.

"18. For completing Courton harbour, in Ireland.

"19. On the proposed railway between Waterford and Limerick.

"20. On the Ulster canal, as proposed, in the north of Ireland.

"21. On the Norwich and Lowestoft navigation, previous to the commencement, and while in progress.

"Mr. Telford has also made the following extensive surveys, by direction of the post office:

"1. From London, by Ware and Royston, and also by Barnet and Hatfield, to Newark on the Trent.

"2. From thence, by York and Newcastle, to Morpeth, also by Doncaster, Boroughbridge, and Durham, to the same place.

"3. From Morpeth by Alnwick, Berwick, and Had-

dington, to Edinburgh; also by Wooller, Coldstream, and Dalkeith, to Edinburgh.

"4. From Boroughbridge, by Hexham, to Carterfell, on the Teviot Ridge; also, from the same place, by Aldstone Moor, down the South Tyne, and across the Irthing river, to Castleton, in Liddesdale.

"5. From Carlisle, by Langholm, top of Ettrick and Farquhair, to Edinburgh.

"6. From Glasgow, across Ayrshire, and along the coast to Stranraer and Portpatrick.

"7. From the Holyhead Road, at Dunchurch, by Tamworth and Lichfield, to Newcastle, Staffordshire, and thence in three several directions to Liverpool.

"8. From Northleach in Gloucestershire, by Monmouth, Brecon, Carmaerthen, and Haverford West, to Milford Haven; also, from Bristol, by Newport and Cardiff, along the shore to Pembroke.

"The genius of this distinguished engineer has not been confined to his profession. At an early period of life, he gave indications of poetical talent; and 'Eskdale,' among his first productions, is reckoned a poem of considerable merit. Unlike the conceited philosopher, ever pluming himself on his own discoveries and success, Mr. Telford is the patron of merit in others, wherever it is to be found; and a friendly intimacy with him of nearly 30 years, of which I am justly proud, enables me to say, that his kind disposition, unaffected manners, and easy access, have been the means of raising many meritorious individuals from obscurity to situations, where their talents have been seen and appreciated.

"Though ever desirous of bringing the merit of others into notice, his own is so much kept out of view, that the orders of knighthood conferred on him, 'Gustavus Vassa, and Merit,' the gold boxes, the medallions of royalty, and the diamond rings from Russia and Sweden, are known only to his private friends."

The Imperial Magazine, before quoted, in addition to several of the works enumerated by Dr. Cleland, mentions, page 298, that in 1790, Mr. Telford was employed by the British Fishery Society, to inspect the harbours at their several stations, and to devise a plan for an extensive establishment at Wick, in the county of Caithness. This work was regularly accomplished, and it has been the chief centre of the herring fishery on that coast, under the name of Pulteney Town.

Many details of Mr. Telford's works are contained in Sir Henry Parnell's Treatise on Roads; London 1833. Pages 33 to 38, 50, 51, 146, 154 to 177, 260, 298, 348 to 361, 366 to 385, with various other notices.

A perusal of those pages will amply repay the reader who delights in tracing the progress of public improvement, and in contemplating the mighty productions of genius.

I find also in your 16th volume of the Repertory of Patent Inventions, page 369, No. 108, for Dec. 1833, in a report of a journey to Stony Stratford in Sir Charles Dance's Steam Carriage, Mr. Telford is one of the party as "Consulting Engineer to the London, Holyhead, and Liverpool Steam Coach Company." Mr. John Macneill being the acting engineer.

Also in the 2nd vol. of your new series, page 40, a "report on the means of supplying the metropolis with pure water," which proves that Mr. Telford's tact for research and discrimination was not at all impaired by his great age (then 76 years).

Mr. Telford has for some time past been gradually retiring from professional business; he has of late chiefly occupied himself in preparing a detailed account of the great works which he planned and lived to see executed; and it is a singular and fortunate circumstance, that his clerk completed the manuscript of the work, under his direction, a few days before his death.

The plates intended to illustrate this work, of which the

following is a list, are finished or in great forwardness; they afford a magnificent idea of the mass of engineering information, that will be afforded to the profession and to the public, when published, which I understand his executors will cause to be done without loss of time.

LIST OF PLATES.

A Map of Great Britain
1 Heriot's Hospital
2 Palace of Holyrood House
3 Doorway of Holyrood Chapel
4 Interior of Holyrood Chapel
5 Aisle of Rosslyn Chapel
6 Commissioners' House, Portsmouth
7 Roman Baths, Wroxeter
8 Roman Tesselated Pavement
9 Salop County Jail
10 Montford Bridge
11 Buildwas Bridge
12 Bewdly Bridge
13 Tongueland Bridge
14 Bridgenorth Church
15 Map of Canals
16 Wide Locks Ellesmere Canal, (including one of cast iron)
17 Bridge, Stop Gate, and Tunnel in ditto
18 Chirk Aqueduct
19 Pont y Cyssylte Aqueduct
20 Map of Caledonian Canal
21 Sea Lock on ditto
22 Lock Gates (timber and iron) on ditto
23 Gate Machinery on ditto
24 Cranes on ditto
25 Waggons on ditto
26 Let off at Strone on ditto
27 Ardrossan Canal & Harbour
28 Weston Point, Weaver Navigation and Section of Sea Wall at ditto
29 Saltersford Weir, Weaver Navigation
30 Harecastle Tunnel
31 Gatton Bridge, Old Birmingham Canal
32 Icknield Street Bridge over ditto
33 Reservoir Embankment, and Discharging Apparatus on ditto
34 Locks and Lock Gates on the Birmingham and Liverpool Junction Canal
35 Cast Iron Aqueduct on ditto
36 Map of the Fens
37 Aberdeen Harbour
38 Plan and Elevation of Pier Head of ditto
39 Sections of ditto
40 Dundee Harbour
41 Graving Dock at Dundee
42 St. Katherine's Docks (Plan)
43 Swivel Bridge at ditto
44 Entrance Lock and Wharf Walls of ditto
45 Map of Gotha Canal (Sweden)
46 Double Lock and Gates, &c. on ditto
47 Double Stop Gate and Drawbridge on ditto
48 Craig Ellachie Bridge
49 Helmsdale and Allness Bridges
50 Conon and Potarch Bridges

51 Laggan Kirk Bridge
52 Dunkeld Bridge
53 View of Dunkeld
54 Fiddler's Burn and Johnstone Mill Bridges
55 Birkwood Burn and Hamilton Bridges
56 Cartland Craigs Bridge
57 Centering of ditto
58 Toll House on ditto
59 Glasgow old Bridge widened with cast iron
60 Glasgow Bridge (Broomielaw)
61 Dean Bridge
62 Centerings of Dean Bridge and Gloster Bridge
63 Pathhead Bridge
64 Morpeth Bridge
65 Holyhead Road, Cross Sections, &c.
66 Ditto, Sections, Drains, Fences, &c. &c.
67 Ditto Toll Houses and Gate
68 Llynnon Waterloo Bridge
69 Menai Bridge
70 Elevation and Sections of Main Pier and Pyramids
71 Side Elevation and Cross Sections of ditto
72 Section of Roadway Main Chains adjusting Links of ditto
73 Hoisting Tackle, Saddles, &c.
74 Proving Machinery and Tackle used in the Menai Bridge
75 Sundry Tackle and Machinery used in the Menai Bridge
76 Conway Bridge
77 Holyhead Harbour
78 Howth Harbour
79 Tewksbury Bridge
80 Gloster Severn Bridge.

There are to be two Tail Pieces,
1 Hermitage Castle (from Scott's Border Antiquities)
2 Caerlavarock Castle (from Vol. IV. of Scott's Poetical Works).

The Courier newspaper of the 3rd instant says, " He was a native of Langholm in Dumfriesshire, which he left at an early age. His gradual rise from the stonemasons' and builders' yard to the top of his profession in his own country, or, we believe we may say, in the world, is to be ascribed not more to his genius, his consummate ability, and persevering industry, than to his plain, honest, straightforward dealing, and the integrity and candour which marked his character throughout life.

" His works are so numerous all over the island, that there is hardly a county in England, Wales, or Scotland, in which they may not be pointed out. The Menai and Conway bridges, the Caledonian Canal, the St. Katherine's Docks, the Holyhead roads and bridges, the

Highland roads and bridges, the Chirke and Pont-y-cisilte aqueducts, the canals in Salop, and great works in that county, of which he was surveyor for more than half a century, are some of the traits of his genius which occur to us, and which will immortalize the name of Thomas Telford.

"We have access to know that he was inclined to set a higher value on the success which has attended his exertions for improving the great communication from London to Holyhead, the alterations of the line of road, its smoothness, and the excellence of the bridges, than on the success of any other work he executed; but it seems difficult to draw a line of distinction with any thing like nicety of discrimination, as to the degree of credit to which an engineer is entitled for ingenuity to plan, and the ability to execute, magnificent and puzzling improvements on the public communications of a great country. The Menai bridge will probably be regarded by the public, as the most imperishable monument of Mr. Telford's fame. This bridge over the Bangor ferry, connecting the counties of Carnarvon and Anglesea, partly of stone and partly of iron, on the suspension principle, consists of seven stone arches, exceeding in magnitude every work of the kind in the world. They connect the land with the two main piers, which rise 53 feet above the level of the road, over the top of which the chains are suspended, each chain being 1,714 feet from the fastenings in the rock. The first three-masted vessel passed under the bridge in 1826. Her topmasts were nearly as high as a frigate; but they cleared 12 feet and a half below the centre of the roadway. The suspending power of the chains was calculated at 2,016 tons; the total weight of each chain, 121 tons.

"The Caledonian canal is another of Mr. Telford's splendid works, in constructing every part of which, though prodigious difficulties were to be surmounted, he was successful. But the individuals in high station, now travel-

ling in the most remote part of the island, from Inverness to Dunrobin castle, or from thence to Thurso, the most distant town in the north of Scotland, will there, if we are not mistaken, find proofs of the exertion of Mr. Telford's professional talent equal to any that appear in any other quarter of Britain. The road from Inverness to the county of Sutherland, and through Caithness, made, not only so far as respects its construction, but its direction, under Mr. Telford's orders, is superior, in point of line and smoothness, to any part of the road of equal continuous length between London and Inverness. This is a remarkable fact, which, from the great difficulties he had to overcome in passing through a rugged, hilly, and mountainous district, incontrovertibly establishes his great skill in the engineering department, as well as in the construction of great public communications.

"These great and useful works do not, however, more entitle the name of Telford to the gratitude of his country, than his sterling worth in private life. His easiness of access, and the playfulness of his disposition, even to the close of life, endear his memory to his many private friends."

The Council of the Institution of Civil Engineers, of which Mr. Telford was President nearly from its commencement, have published the following judicious, eloquent, and well-earned tribute to his memory :—

"The Council of the Institution of Civil Engineers feel themselves called upon to address the members of that body on the occasion of the great loss they have sustained by the death of their venerable President, to express their high sense of his talents and eminence as a professional man, and their heartfelt respect for his memory. His various works are conspicuous ornaments to the country, and speak for themselves, as the most durable monument of a well-earned fame: in number, magnitude, and usefulness, they are too intimately connected

with the prosperity of the British people to be overlooked or forgotten in future times; and the name of Telford must remain permanently associated with that remarkable progress of public improvement which has distinguished the age in which he lived.

"The boldness and originality of thought in which his designs were conceived, has been only equalled by the success with which they have been executed, and by the public benefits which have resulted from their use; whilst the general admiration with which his structures are regarded is an evidence of his good taste, in giving elegance of appearance to the most substantial fabrics.

"The profession in which, during a long and successful career, Mr. Telford was one of the brightest ornaments, has been greatly advanced in public estimation by his unceasing efforts for its improvement. The members of that profession can never forget the liberality with which he patronised and encouraged young men, his ready accessibility, and the uniform kindness of feeling and urbanity of manners evinced in his intercourse with every one.

"The Institution of Civil Engineers has been particularly indebted to Mr. Telford, who was chosen president at an early stage of its formation, and has always exerted his influence to promote its objects and consolidate its foundation; his presents to the library and collection have been most liberal, his attendance at the meetings constant, and his conduct in presiding has been in every way calculated to promote mutual good feelings, harmony of sentiments, and co-operation of talents."

I have been informed, on good authority, that Mr. Telford entered London with only one guinea in his pocket. That, while employed at Somerset House, he took his dinners at an eating-house in Lancaster Court, Strand, which he pointed out to a friend 40 years afterwards who then dined there himself.

That he taught himself Latin, French, Italian, anp German; and could read those languages with facility, and converse freely in French.

That he understood Algebra well, but cried it down as leading too much to abstraction and too little to practice.

From my own observation, and many years study of his character, I should say, that he was not a man of science so much as a man of innate and quick perception of the nature and fitness of things, and of uncommon circumspection, carefully weighing and re-weighing all the points bearing upon the object of his pursuit. He held mathematical investigation rather cheaply, and always resorted to experiment when practicable, to determine the relative value of any plans on which it was his business to decide. He was not an inventor in a wide sense of the term, but readily adapted well-proved means to his ends. He has told me that he took one patent in his life time, and it gave him so much trouble, that he resolved never to have another, and kept his resolution. Mr. Telford's great work, the Menai bridge, occasioned him more intense thought than any other of his works; he told me last winter, that his state of anxiety for a short time previous to the opening of the bridge, was so extreme, that he had but little sound sleep; and that a much longer continuance of that condition of mind, must have undermined his health. Not that he had any reason to doubt the strength and stability of every part of the structure, for he had employed all the precautions that he could imagine useful, as suggested by his own experience and consideration, or by the zeal and talents of his very able and faithful assistants, yet the bare possibility that some weak point might have escaped his and their vigilance in a work so new, kept the whole structure constantly passing in review before his mind's eye, to examine if he could discover a point that did not contribute its share to the perfection of the whole.

Mr. Telford delighted in employing the vast in nature

to contribute to the accommodation of man. His eyes once glistened with joy, at a relation of the conception of a statue being cut out of a mountain, holding a city in its hand; he exclaimed that the suggestor was a magnificent fellow!

A friend one day was describing a minute process, into which Mr. Telford's mind was too large to enter with interest; after some time he said, in his very good humoured way, "Come! be off with you, you are thinking of mites, and I of mountains." Yet he did not despise minutiæ, but liked to see those whom nature fitted for critical investigations of her laws and capabilities, sedulously employed in exploring the most minute ramifications of her operations, but he viewed such precedings only as means to great ends. He valued means only as means, and never dwelt in them, but ran through them, carrying away with him, all that would serve to forward his ends. On one occasion, I pointed out to him, in company, a celebrated artist; I said that nature had made him a painter, but that his hobby was engineering, "Why then," said Mr. Telford, "between you and I, he is a fool."

Nature and practice had so formed Mr. Telford's eye for judging of levels, that he has often been known to ride through a country and point out the line which a canal must take, and subsequent surveys have confirmed his views.

Mr. Telford, was to the latest period of his life, very fond of young men and of their company, provided they delighted in learning; he encouraged them to pursue their studies in such a manner, as to acquire an exact knowledge of the laws and operations of nature, in order that they might, in after life, bring that knowledge to bear upon their engineering undertakings.

In all his great works, he employed, as sub-engineers, men of talent, capable of appreciating and acting on his plans; but he was no rigid stickler for his own plans, for

he most readily acquiesced in the suggestions of his assistants, when reasonable, and thus identified them with the success of the work.

In ascertaining the strength of materials for the Menai bridge, he employed men of the highest rank for scientific research and attainments.

Mr. Telford was never married. His servants speak of him as the kindest of masters. He never troubled himself about domestic affairs, nor cared what he eat or drank, but left all those minor matters of life to their management. He was a great reader, and generally retired to bed before 12, and read himself to sleep; rose at 7; finished breakfast before 8, at which hour he entered his office to business. His punctuality was universal. That he had a particular aversion to the keeping of large bodies of men of business waiting for him, the members and associates of the Institution of Civil Engineers can bear ample testimony; and he was not more endeared to them by virtue of his very numerous and valuable presents of books, plans, carpets, lamps, &c. &c., than by his inestimable presents of punctuality and urbanity. He might well be held up as an example to some presidents of societies, who habitually waste the time of multitudes, whose talents might be beneficially employed for themselves and for society.

Dr. Cleland in the extracts above given, alludes to Mr. Telford's early indications of poetical talent; and the Mechanic's Magazine, No. 574, for Sept. 13, 1834, vol. xxi. p. 415, contains some beautiful lines addressed to Burns, which I must not transcribe, because literary curiosities do not comport with the plan of your scientific journal.

But I hold that Mr. Telford was a poet of the highest order all his lifetime, not a mere rhyme-stringer, into which almost any dunce might be drilled. But the poetry of his mind was too mighty and lofty to dwell in words and metaphors; it displayed itself by laying the sublime

and the beautiful under contribution to the useful, for the service of man.

His Caledonian Canal; his Highland Roads; his London and Holyhead Road are poems of the most exalted character, divided into numerous cantos, of which the Menai bridge is a most magnificent one. What grand ideas can words raise in the mind to compare with a glance at that stupendous production of human imagination!

But I must not transgress your limits any longer; Mr. Telford's occupancy of so large a space in the public mind, from the remarkable extent of his successful engineering works, must be my apology for dwelling so long upon the subject.

I will now conclude with the last quotation of the Imperial Magazine, in the account before adverted to, "Go, copy the example, and imitate the conduct, of Mr. Thomas Telford."

An Old Member of the Institution of Civil Engineers.

London, Sept. 24, 1834.

CRITICAL NOTICES AND REVIEWS.

The Civil Engineer and Mechanist.—Practical Treatise of Civil Engineering, Building, Machinery, Mill-work, Engine-work, Iron-founding, &c. &c. Designed for the Use of Engineers, Iron Masters, Manufacturers, and Operative Mechanics. Part I.—Boulton and Watt's Portable Steam-Engine, complete. By Charles John Blunt and R. Macdonald Stephenson.—London: Ackerman & Co., 1834.

This work was some months ago advertised as a splendid work on civil engineering, and was promised to be "a comprehensive text-book for civil engineers, the higher order of mechanics, and for all manufacturers;

which shall exhibit the actual practice of civil engineering, and its applications; affording minute detail and measurement; working plans, in the strict acceptation of the expression; accompanied by reports, estimates, and descriptive specifications, of character sufficiently extensive, distinct, and popular, to enable the directing engineer and manufacturer promptly to arrange, and the operative engineer as readily to execute, a given work."

"And this will be effected BY A LUCID ARRANGEMENT AND CLASSIFICATION OF EVERY KNOWN WORK AND ACTUAL OPERATION, BETWEEN WHICH AND THE WORK IN HAND, A PARALLEL CAN BE DRAWN, AND PRACTICAL INFERENCES TAKEN. In these statements, a simple and perspicuous language, with an actual view of each case, will methodize, and bring into a *convenient, applicable, and economical form,* a vast mass of information, now to be obtained only either by the extensive practice of a long professional life, or by a laborious, and too often unsatisfactory reference to voluminous reports of mixed character, scattered through a maze of books, rendering the reference in all cases tedious and inconvenient, and, to a vast number of most useful and practical men, altogether impracticable."

"An important peculiarity of this work is, that, in most cases of general business, it will spare the need of voluminous and costly drawings, the plates themselves possessing, to the engineer and mechanic, the invaluable merit of being the faithful, actually operative, plans of detail, and bringing together, in a practical form, a circumstantial and workmanlike display of the present state of the art, and OF ALL EXISTING WORKS OF CHARACTER AND INTEREST."—(*Advertised Preface.*)

This work was originally proposed to appear as a whole, but circumstances have induced the authors, unadvisedly, we think, to bring it out in a series of parts. We have delayed our notice a month, in the expectation that by so doing we should allow time for the appearance of the

second Part, and thus have been in possession of an enlarged sample of the proposed publication, which would have enabled us to form some idea of the probable value of the proposed Civil Engineer. In this we have been disappointed—the second Part has not yet come out. The public have been so often disappointed by works appearing in parts and never being completed, that they are naturally careful how they commence taking a work, unless they have some guarantee that it will be gone on with: this care becomes the more necessary when the Parts or Numbers are costly, as in the present instance.

The published Part consists of twelve sheets of working drawings shewing, in elevation and detail, what is said to be a Boulton and Watt's twenty-horse power steam-engine. These drawings are 27 by 21 inches, most of the details being represented on a scale of three inches to a foot; there are then 17 pages of letter-press, consisting merely of letters and figures of reference to the various parts, but no practical rules on the science of steam, and the construction and working of steam-engines; and yet we are promised a practical treatise. We are not told how many Parts or Numbers the subject of the steam-engine is to occupy: the marine-engines of Boulton and Watt, their pumping-engines, their boilers and furnaces, will, we presume, as a matter of course, have to be shewn in detailed drawings: then we think, in order to give a clear knowledge of the state of this branch of the profession, there ought to be engines, boilers, and furnaces, of other of the principal makers: there are also the various descriptions of high pressure and expansive engines; these it will be requisite to give in order to produce a work of any value on steam-engines; and to do this, even in the same style as the Part now before us, and without entering into the science involved in the steam-engine, would require fifteen or twenty Parts, and at a cost of as many pounds, which is an amount far too large for most persons interested to become subscribers.

The truth is, that the work is commenced on much too extensive a scale, that is, in its outward dimension, whilst the information it contains is small indeed. In reading over the high sounding pretensions held out in the advertised preface, and comparing them with the first Number of the publication, it will be readily perceived that the draftsmen have undertaken a task their minds are incapable of performing. The work is stated to be "*for the use of engineers, iron masters, manufacturers, and operative mechanics;*" but of what use, we would ask, are the drawings of a single engine, assuming they are correct, without rules by which the dimensions of the parts of engines of other power than that represented, can be obtained. We have here a twenty-horse engine, said to be Boulton and Watt's; this however is no guide if it be desired to construct a thirty, forty, or fifty-horse power. If, therefore, the work is intended to instruct persons in making engines, it fails of its object, for it in reality tells no more than what relates to one engine. On the other hand, if the publication is intended for a practical man, it equally fails, for the drawings of one engine can be of little use to him.

It is somewhat difficult to review merely drawings when they are not before our readers at the time of perusing our observations. We do not, therefore, propose entering into the various incorrectnesses, which, though they would not be of material consequence to a practical man, is to the learner an insuperable objection to the work; indeed, the drawings cannot be relied on.

There is one observation which we consider most material, and must on no account be omitted,—it is this—the engine shewn in the drawings is, as before observed, stated to be one of Boulton and Watt's, yet there is not one dimension which falls in with those of that celebrated firm: the induction or steam-pipe is considerably less; the length of stroke is less, and consequently all the parts depending on the length of stroke are different; and yet this is a

publication purporting to give *faithful plans "of all existing works of character and interest."* Indeed, it is our opinion that the drawings are from a French engine; but of this we are certain—Boulton and Watt never made an engine with such dimensions. It is true the publication does not claim to give novelties of the authors' own, but a correct representation of what has been well done by others; it must therefore be evident, that to attribute an engine of one manufacturer to another is a serious injustice to the parties concerned. We cannot but express our surprise, that amongst the many hundreds of engines to be found in England, the publishers have not been able to obtain a correct set of drawings of a *real* Boulton and Watt, without having recourse to foreign representations.

We should have been happy to have given a favourable opinion of the work, because we think there is room for a good one; for with the exception of Tredgold* on the Steam-engine, which, though highly valuable, it must be confessed, is the result more of theory than practice,—there is no good book on the subject. A work combining theory with practice, and illustrated with working drawings of known engines, would unquestionably be a valuable addition to the libraries of engineers and others interested; but we do not expect such a work from the pens of two individuals who imagine themselves capable of giving *"a lucid arrangement and classification of every known work which shall exhibit the actual practice of civil engineering."* This is a task too great for any two individuals; and, for ourselves, we shall prefer to purchase works of separate authors, who confine themselves to writing on those branches of the subject with which they are practically acquainted.

We shall take an early opportunity of noticing the next Number when it shall be published; and we hope to be able to give a more favourable opinion.

* There is the first vol. of Mr. Farey's work, but there is no promise of its completion.

NOTICE OF EXPIRED PATENTS,

(*Continued from p.* 189.)

SAMUEL PARKER, of Argyle-street, Middlesex, Bronzist, for an improved lamp. Sealed June 15, 1820.

WILLIAM ERSKINE COCHRANE, of Somerset-street, Portman-square Middlesex, Esq. for an improvement in the construction of lamps.—Sealed June 17, 1820.—(*For copy of specification, see Repertory, Vol.* 40, *second series, p.* 7.)

JOSEPH WOOLLAMS, of Wells, Somersetshire, Land Agent, for certain improvements in the teeth or cogs formed on, or applied to, wheels, pinions, and other mechanical agents, for communicating or restraining motion.—Sealed June 20, 1820.—(*For copy of specification, see Repertory, Vol.* 40, *second series, p.* 1.)

LIST OF NEW PATENTS.

ENGLAND.

JOHN BEARD, of the Parish of Leonard Stanley, in the County of Gloucester, for certain improvements in machinery for dressing woollen cloth.—Sealed September 1, 1834.—(*Six months.*)

GEORGE JOSEPH GREEN, JOHN OGDEN BACCHUS, and WILLIAM GAMMON, of Birmingham, in the County of Warwick, Glass Manufacturers, for improvements in the manufacture and working of plate and other glass. Communicated by a foreigner residing abroad.—Sealed September 1, 1834.—(*Six months.*)

JOHN CHANTER, of Stamford Street, in the County of Surrey, and of Earl Street, Blackfriars, in the City of London, Gentleman, for an improvement in furnaees.—Sealed September 2, 1834.—(*Six months.*)

JOHN JOSEPH CHARLES SHERIDAN, of Walworth, in the County of Surrey, Chemist, for certain improvements in the several processes of saccharine onions and acetous fermentation.—Sealed September 6, 1834.—(*Six months.*)

William Longfield, of Otley, in the County of York, Whitesmith, for an improved lock or fastening for doors, and other situations where security is required.—Sealed September 6, 1834.—(*Six months.*)

Henry Shrapnel, of Salisbury, in the County of Wilts, Major-General and Colonel in the Royal Artillery, for improvements in fire-arms of various descriptions, and in ammunition for the purposes of fire-arms.—Sealed September 6, 1834.—(*Six months.*)

Miles Berry, of 66, Chancery Lane, in the Parish of Saint Andrew, Holborn, in the County of Middlesex, Civil Engineer, for certain improvements in mills for grinding wheat and other grain; and which improvements render them also applicable to other purposes. Communicated by a foreigner residing abroad.—Sealed September 13, 1834.—(*Six months.*)

Stephen Perry, of Wilmington Street, Wilmington Square, Gentleman, and Edward Massey, Senior, of King Street, Clerkenwell, Watch Manufacturer, and Paul Joseph Gauci, of North Crescent, Bedford Square, Artist, all in the County of Middlesex, for certain improvements in pens and penholders.—Sealed September 20, 1834.—(*Six months.*)

Edward Weeks, of King's Road, Chelsea, in the County of Middlesex, Horticultural Builder, for certain improvements on kitchen or other grates or ranges, which he denominates, Weeks' Cooking Apparatus. — Sealed September 20, 1834.—(*Six months.*)

SCOTLAND.

Thomas Sharp, Merchant, and Richard Roberts, Engineer, both of Manchester, in the County Palatine of Lancaster, for an invention communicated to them by a foreigner residing abroad, of certain improvements in machinery for grinding corn and other materials.—Sealed July 11, 1834.

Charles Wilson, of Kelso, in the County of Roxburgh in that part of the United Kingdom of Great Britain and Ireland called Scotland, for certain improvements applicable to the machinery used in the preparation for spinning wool and other fibrous substances.—Sealed July 17, 1834.

William Septimus Losh, of Walker, in the County of Northumberland, Gentleman, for an improved method of bleaching certain animal fats and certain animal, vegetable, and fish oils.—Sealed July 17, 1834.

Joseph Shee, of Lawrence Pountney Place, in the City of London, Gentleman, for certain improvements in distillation.—Sealed July 17, 1834.

James Hamilton, of Threadneedle Street, in the City of London, Civil Engineer, for certain improvements in machinery for sawing, boring, and manufacturing wood applicable to various purposes.—Sealed July 17th, 1834.

John Aston, of Birmingham, in the County of Warwick, Button Maker, for an improvement in the manufacture or construction of buttons.—Sealed July 21, 1834.

John Gold, of Birmingham, in the County of Warwick, Glass Cutter, for certain improvements in cutting, grinding, smoothing, polishing, or otherwise preparing glass decanters, and certain other articles.—Sealed July 21, 1834.

Peter Wright, of the city of Edinburgh, Manufacturer, for an improved method of spinning, twisting, and twining cotton, flax, silk, wool, or any other suitable substance.—Sealed July 22, 1834.

Isaac Jecks, junior, of Bennett's Hill, in the City of London, Gentleman, for an apparatus or machine for putting or drawing on or off boots.—Sealed July 25, 1834.

Luke Hebert, of the Hampstead Road, in the county of Middlesex, Civil Engineer, for certain improvements in machines or apparatus for and in the process of manufacturing bread and biscuits from grain.—Sealed July 30, 1834.

Richard Simpson, late of Rouen, in the Kingdom of France, but now residing in Southampton Row, Bloomsbury, in the county of Middlesex, Gentleman, for an invention communicated to him by a foreigner then resident in France, of certain improvements in machinery for stubbing and roving wool and cotton.—Sealed August 1, 1834.

William Higgins, of Salford, in the County of Lancaster, Machine Maker, for an invention communicated to him by a foreigner residing abroad, of certain improvements in machinery used for making twisted rovings and yarn of cotton, flax, silk, wool, and other fibrous substances.—Sealed August 5, 1834.

Henry Ewbank, of Idol Lane, in the City of London, Merchant, for an invention communicated to him by a foreigner residing abroad, for dressing rough rice or paddy and certain other grain, by rubbing off its skin or pellicle, and re-dressing or cleansing rice.—Sealed August 5, 1834.

Daniel Ledsam, and William Jones, both of Birmingham, in the County of Warwick, Screw Manufacturers, for certain improvements in machinery for making pins, needles, rivets, wood screws, and nails.—Sealed August 6, 1834.

John Rapson, of Penryn, in the County of Cornwall, Engineer, for an improved apparatus for facilitating the steering of vessels of certain descriptions.—Sealed August 18, 1834.

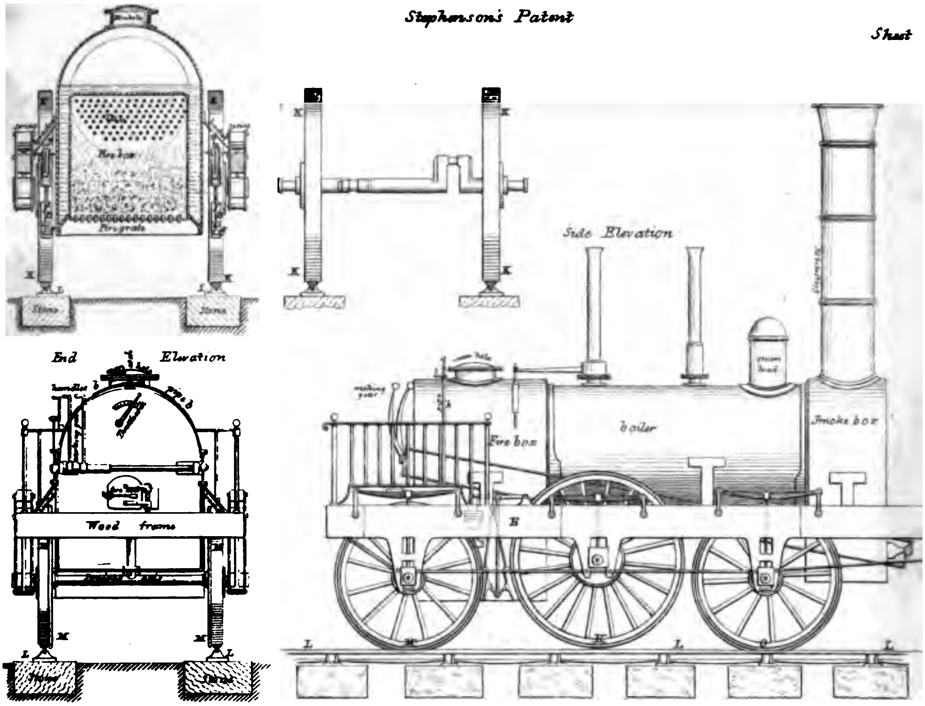
William Hale, of Colchester, in the County of Essex, Engineer, for certain improvements in or on windmills, which improvements are applicable to other purposes.—Sealed August 26, 1834.

Joseph Whitworth, of Manchester, in the County palatine of Lancaster, Mechanist, for certain improvements in machinery or apparatus for cutting screws.—Sealed August 29, 1834.

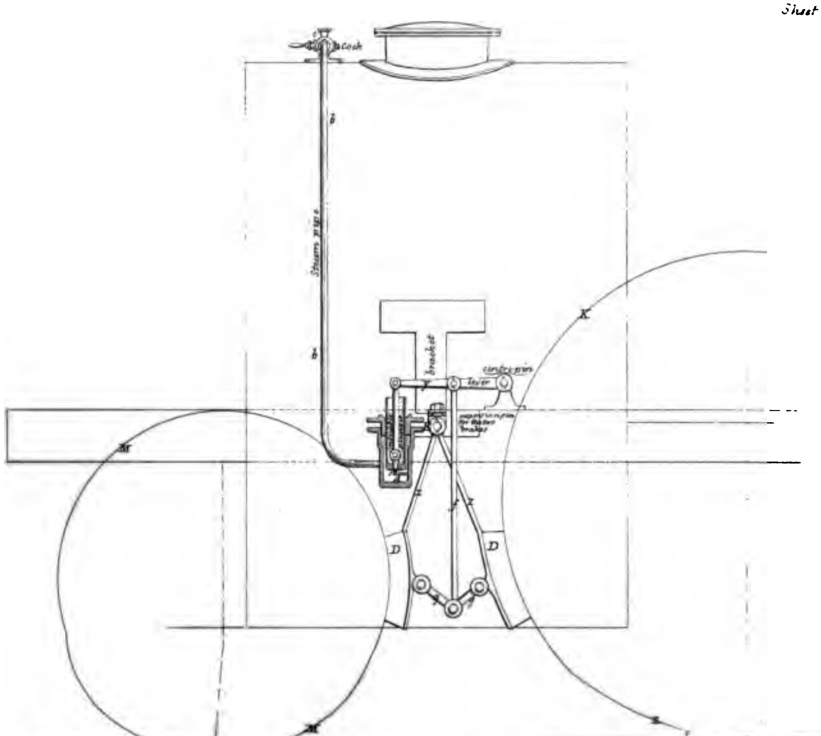
Transverse Section *Plate XI. Vol. II. New Series.*

Stephenson's Patent

Sheet



Sheet 11.



THE

REPERTORY

OF

PATENT INVENTIONS.

No. XI. NEW SERIES.—NOVEMBER, 1834.

Specification of the Patent granted to ROBERT STEPHENSON, *of Newcastle-upon-Tyne, in the County of Northumberland, Engineer, for a certain Improvement in the Locomotive Steam-Engines now in Use for the quick Conveyance of Passengers and Goods upon Edge Railways.*—Sealed October 7, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said Robert Stephenson, do hereby declare that my said invention is described in manner following (that is to say):

My improvement in the locomotive steam-engines, now in use for the quick conveyance of passengers and goods upon edge railways, is applicable to that kind of locomotive engines which are used in the Liverpool and Manchester railway (the first of which engines was called by the name of the Planet), having the two main wheels, which are impelled by the engine, fixed on a double-cranked axis, and turned round by the force of the pistons of the steam-cylinders, in order to advance the locomo-

tive-engine along the edge-rails, whereon the said main-wheels bear. And my said improvement consists in making the said main-wheels of the locomotive-engine (which are fixed as aforesaid) on the ends of the cranked-axis, and impellled by the force of the pistons, with plain tires to run upon the edge-rails without any projecting flanges on those tires, and applying two additional small wheels with flanges on their tires, beneath the hinder end or part of the engine, in order to cause that end of the engine, by means of those flanges, to keep straight upon the rails, as it runs along thereon, and also to bear up part of the weight of the furnace-end of the boiler, in the same manner as the present two small wheels (by means of their flanges) keep that end of the engine straight on the rails, and bear part of the weight at the chimney-end of the boiler, where the steam-cylinders are situated. And also consists in applying the force of small extra steam-pistons, or plungers, fitted into suitable cylinders, which by turning a cock, can be supplied when required, with steam from the boiler, in order to act upon a double brake, or pair of clogs, which are applied to the circumferences of the tires of the said main-wheels without flanges, and of the two said additional small wheels with flanges, so as to press the said brakes or clogs in contact with the said circumferences, and thereby cause friction and resistance, which will tend to retard the motion of the wheels, and consequently the advance of the engine, along the rails in order to stop the same when required.

The object of my said improvement is, to obviate or diminish some inconveniences which have been experienced in the use of such locomotive engines, for the quick conveyance of passengers and goods, on the said Liverpool and Manchester railway, viz., that the cranked-axles of the great wheels, have been found liable to break, and then the engines run off the rails, and sometimes overturn, or are otherwise injured. They have, also, in some cases run off the rails when the cranked-axle has

been only strained, without being actually broken; also it is found difficult to hold on, with the clogs or brakes to the wheels of such locomotive-engines, according to the manner whereby the brakes are usually applied by hand, with sufficient force and steadiness, to retard the engines from advancing along the rails, as much as is desirable, in order to arrest their motion as suddenly as possible, when they have been travelling rapidly, and particularly in the event of arriving at a broken or deranged part of the rail-road, or on any other occurrence which may occasion danger of collision with obstacles or other carriages, if the motion were not stopped with promptitude; and also the boilers of those engines have burned out very rapidly, in their internal tubes, so as to have occasioned great expense and loss of work in repairing them.

My said improvement in such kind of locomotive-engines, will tend to obviate or diminish the said inconveniences, for by using plain tires, without flanges, for the main impelled wheels (and which has never been done before in such engines, on edge railways), the cranked-axle of those wheels will not be subjected to any strain end-ways, in the direction of its length, when the engine enters into sidings, turnings, and crossings of the rails, or passes along curvatures in the line; for that is probably the most severe strain to which the cranked-axles have been hitherto subjected, and is thought to be that whereby they have been commonly strained and broken, for at every siding, turn off, or curvature in the road, the locomotive engine will have a tendency to run off the rails sideways, and which tendency can only be resisted or counteracted by the flanges on the wheels, bearing laterally against the inside edges of the rails, on the concave side of their curvature, and in entering turns off, the lateral bearing of the flanges is very forcible, but it is evident that to afford such a resistance, or counteraction to running off the rails, the axles on which the wheels are fixed must be severely tried. The axles of the small

wheels in such engines being straight, and consequently shorter than the cranked-axles, and having only to bear a weight acting downwards, without any twisting, and from the small size of those wheels, such straight axles being strained laterally with a shorter leverage, have been found sufficiently strong, and have been rarely broken, but the cranked-axles being (in consequence of their cranked form) of much greater length, and being very powerfully urged by the force of the pistons, with a bending and twisting action combined, have frequently failed, most probably from the additional stress to which they have been subjected by the lateral action of the flanges of the impelled wheels against the inside edges of the rails, whenever from entering sidings, or turns off, or passing along curvatures of the rail-road, the engine has had a tendency to run off the rails, which lateral action of the flanges, of the impelled wheels, against the edges of the rails, owing to the large size of those wheels, and the great length of the cranked-axle, has operated with powerful leverage to bend and break the cranked-axle, and the instant that, from such cause, the axle has been strained or bent, so as to put the main-wheels out of square, with the axle, they would from that moment acquire an increased tendency to lateral bending of the axle, and running off with a sideway hinging motion of the whole engine. It is evident that any lateral bending of the cranked-axle, although far short of a fracture, will, by putting the wheels out of square, produce a violent surging motion of the whole engine sideways, in its further progress along the rails, and such an extra action must be very liable to break the cranked-axle or run the engine off the rails. The said tendency to bend or break the cranked axle will be very greatly dimished by divesting the tires of the main impelled wheels of their flanges, and trusting entirely to the flanges of the two additional small wheels, which must, according to my improvement, be applied beneath the fire-place end of the boiler, for keep-

ing the engine straight on the rails, in its progress forwards, and the axle of those wheels being straight, may be expected to be sufficient to be capable of enduring the stress to which it will be subjected, in so keeping the engine on the rails, without breaking or bending: for the past experience has proved the sufficiency of the present straight axles of the small wheels. And by applying the pressure of steam from the boiler, to act within hollow cylinders, upon pistons or plungers fitted into those cylinders, so as by the motion given to those pistons by the steam, when admitted into the said cylinders, to force the brakes or clogs, against the edges of the wheels, in order to retard the same, by causing friction and thereby stopping the advance of the locomotive-engine on the rails. The stopping may thereby be effected with more promptitude, and with less trouble and effort than by the ordinary mode hitherto practised of applying the clogs or brakes, by the strength of the man, who attends the engine; for, according to my improvement the man, when warned of any danger, requiring the locomotive-engine to be stopped, as suddenly as possible, after having as usual stopped off the supply of steam to the engine-cylinders, will have nothing to do, in order to apply the brakes or clogs, but to turn a cock in a small steam-pipe, which conducts the steam from the boiler into the said hollow cylinders, wherein the said pistons or plungers are fitted, and the steam being (by opening the cock) admitted to act upon those pistons or plungers, will bring the clogs or brakes into action, with far more effect than can be done by the common mode of pressing them against the wheels by handle-levers, actuated by man's strength; and also according to my improvement, the man, after having opened the said cock, and so brought the brakes or clogs into action by the force of steam, will have his hands at liberty to do any other duty that may be required of him whilst the engine is stopping. And note—the same effect may be produced by admitting water from the boiler, by

a pipe and cock as aforesaid, into the said hollow cylinders, in lieu of steam, because the pressure of the water will produce the same effect on the pistons or plungers and clogs or brakes, as that of the steam. And in order to release the said clogs or brakes, and take them out of action, the aforesaid cock must be shut, to cut off the communication from the boiler, to the hollow cylinders wherein the pistons are to act, and another cock being opened to permit the steam (or water) which has operated in the hollow cylinders, to escape therefrom into the open air, and allow the pistons or plungers in those cylinders to return and release the brakes or clogs; or the same cock which admits the steam or water from the boiler into the said cylinders, may be made with a double passage so as to allow the steam or water to escape into the open air when the cock is turned in an opposite direction, or to shut both passages when turned into an intermediate position. The inconveniency of wearing out the boilers may be diminished when locomotive-engines are constructed according to my said improvement, for by using six wheels to support the engine, larger boilers may be employed. The additional small wheels which I apply beneath the hinder end of the boiler, will sustain the extra weight of a larger boiler than heretofore used, without distressing the rails; and bearing-springs are to be used for the extra small wheels, the same as is now done for other wheels in the ordinary engines, and the said springs will cause all the six wheels to apply and bear fairly on the rails, and ease all jolts and concussions. The relative weights or portions of the whole weight of the engine, which shall be borne by each of the six wheels being regulated by the strength and setting of their respective bearing-springs. The main-wheels which are to be impelled by the power of the engine being in all cases left loaded with as much of the weight of the engine as will cause a sufficient adhesion of those wheels to the rails to avoid slipping thereon. When by virtue of my

improvement, a larger boiler is used, containing more heating-surface than heretofore, a less intense excitement of the combustion will be required in order to produce the necessary quantity of steam for the supply of the engine, and that diminution of the intensity of the combustion will be advantageous to the performance of the engine for another reason, as well as by avoiding the heretofore rapid burning out of the metal of the boiler, because the jet of waste steam (which is thrown into the chimney to produce a rapid draft therein, and a consequently intense combustion of the fuel), may be greatly diminished in its velocity, and thereby the waste steam will be allowed to escape more freely from the cylinders than heretofore, when a very sharp and sudden jet of the waste steam up the chimney is found absolutely necessary to excite that intense violence of combustion which can alone enable the present boilers to yield the requisite supply of steam, but that very sudden jet can only be obtained by throttling the eduction-passage, and thereby impeding the free discharge of the steam from the working-cylinders, so as to impair the force of the pistons: and at the same time the excessive combustion which is excited (by so impairing the force of the pistons), also destroys the metal of the boiler in a short time. Increasing the magnitude of the boiler, giving a larger extent of heating-surface thereto, and working the enlarged boiler with a more moderate intensity of fire, is the true remedy, and will save fuel as well as avoid the rapid destruction of the boiler, because the steam will be allowed to escape more freely from the cylinders. The adoption of larger boilers in the said locomotive-engines, with all the advantages to be derived therefrom as aforesaid, depends upon the application of the two additional small wheels beneath the furnace end of the boiler, because the present engines are already too heavy on the rails, and require a diminution of weight, instead of an augmentation. But I wish to be understood, that I do

not claim the use of six wheels instead of four, as an improvement merely for better supporting the weight distinct from other circumstances hereinbefore set forth, but I claim the using of large wheels without flanges on their tires, which wheels are to be fixed on the cranked-axle to serve for the impelled wheels of locomotive-engines, which are to travel on edge railways and in conjunction therewith (but not without that conjunction); the application of a pair of extra small wheels with flanges on their tires beneath the hinder end of the boiler, with interposed bearing-springs, like those of the other wheels; that application of extra small wheels with flanges, conjointly with the said using of large impelled wheels without flanges, being for the purpose of keeping the engine straight on the rails when it runs forwards, as well as for bearing up part of the weight. And also I claim, as part of my said improvement, the application (as hereinbefore described) of the pressure of the steam or water from the boiler, to act when required in hollow cylinders on pistons or plungers, which are connected with the clogs or brakes for the wheels, so as to bring the said brakes or clogs into action by the pressure of the steam instead of by the strength of men, as heretofore done. Note—I make no claim to the use of six wheels in locomotive-engines to travel on edge railways, if the impelled wheels have flanges, but only when the said impelled wheels have no flanges. And for the more complete explanation of my said invention, I have hereunto annexed three sheets of drawings, representing two locomotive-engines for the quick conveyance of passengers and goods upon edge railways, when constructed according to my said improvement.

Sheet I. contains a side-elevation, and elevation, and end-section, of such an engine. K, are the main impelled wheels on the cranked-axle, without any projecting flanges on the tires, which run on the edge-rails. L, M, are the extra small wheels with flanges, applied beneath the hinder or furnace-end of the boiler; and O,

are the ordinary small wheels with flanges beneath the chimney-end of the boiler where the working steam-cylinders are situated. The small wheels, O, and M, with flanges, keep the engine straight on the rails as it runs forwards thereon; and the large impelled wheels, K, have only to advance the engine forwards, and to bear a due portion of its weight, without having anything to do with keeping the engine on the rails, having no flanges which can hold laterally on the rails; wherefore the cranked-axle of the wheels, K, is liberated from all stress by any lateral action of the great wheels, K, against the edges of the rails; and the small wheels, O, M, with flanges (which wheels have straight axles), sustain all the stress of that lateral action.

Sheet II. contains a separate drawing of the brake or clog, which is also shewn in its place in sheet I. A, is the hollow cylinder into which a plunger is fitted, to act by a lever, *y*, and an upright rod, *f*, upon the two clogs or brakes, D, D, which are suspended by pendulous links, *z*, from a centre-pin or bolt, E, fixed to the frame. The clogs or brakes, D, D, are caused to apply to the circumferences of the tires of the wheels, K, and M, by means of links, *g*, *g*, which are interposed between the two clogs or brakes, D, D, and which links when put down into an angle, as shewn in the figure, leave the brakes or clogs, D, D, free of the wheels, K, and M; but when by opening the cock, *c*, the steam from the boiler is admitted through the pipe, *b*, *b*, into the hollow cylinder, A, it raises up the plunger therein, and that by its lever, *y*, and rod, *f*, draws up the links, *g*, *g*, towards a straight line, and then they force the two clogs or brakes, D, D, apart from each other against the wheels, K, and M, with an increased force beyond that which the plunger exerts; that increase of force being in consequence of the leverage at *y*, and the oblique direction of the links, *g*, *g*. When the handle of the cock, *c*, is turned the other way,

it allows the steam to issue through an upright spout, and escape from the cylinders into the open air.

Sheet III. represents another locomotive-engine, such as is now in use, but with my improvement added thereto. The foremost wheels at the chimney-end of the boiler are impelled by means of outside cranks and connecting-rods, as well as the two middle wheels, K, which are on the cranked-axle, in other respects the improvement is the same as in the other engine represented in sheet I. The brakes or clogs are not represented, but if such brakes or clogs are required, they may be applied as hereinbefore described, and shewn in sheets I., and II.—In witness whereof, &c.

Enrolled, December 3, 1833, *in the Rolls Chapel.*

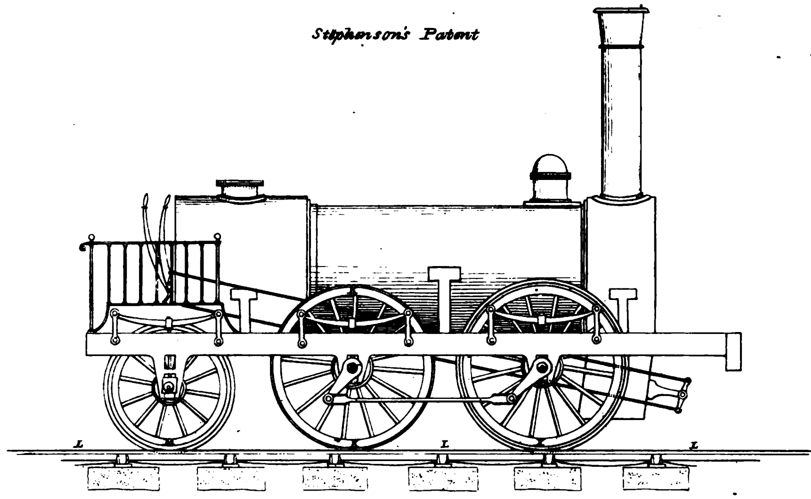
Specification of the Patent granted to ROBERT STEPHENSON *the younger, lately of St. Mary's Cottage, Downshire Hill, Hampstead, (but now of Haverstock Hill, Hampstead,) in the County of Middlesex, Civil Engineer, for an Improvement in the mode of Supporting the Iron Rails for Edge Railways.*—Sealed December 11, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Robert Stephenson the younger, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained in manner following, and by the aid of the two sheets of drawings hereunto annexed (that is to say):

My said improvement in the mode of supporting the iron rails for edge railways, relates to the construction of the chairs or iron supports, in which the iron rails for

Stephenson's Patent



Stephenson's Patent

An Improvement in the mode of supporting the Iron Rails for Edge Railways

Perspective View

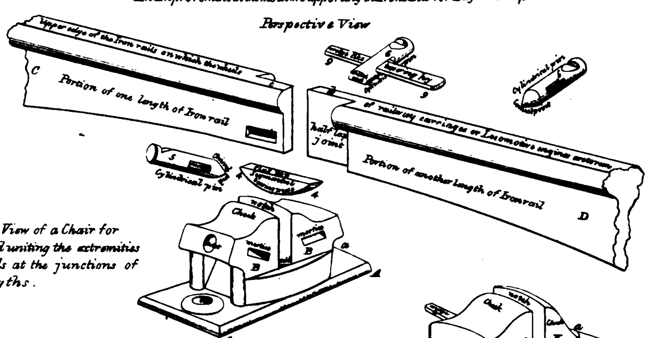


Fig 1 Perspective View of a Chair for supporting and uniting the extremities of the Iron Rails at the junctions of the several lengths.

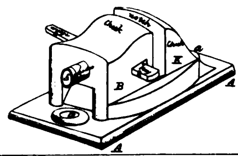


Fig 5. Perspective View of a Chair for supporting the Iron Rails at intermediate distances between the junctions of the several lengths.

Fig 2 Lateral Elevation

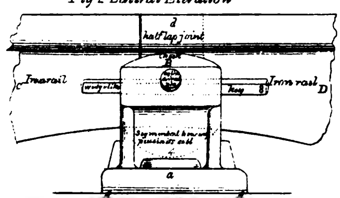


Fig 3. Transverse Section

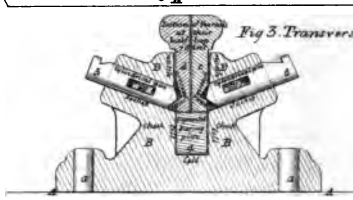
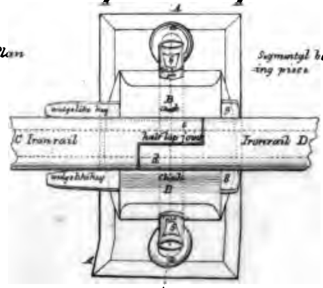


Fig 4.
Horizontal Plan



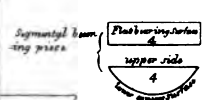
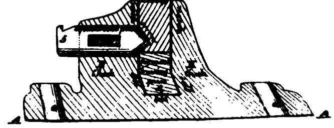


Fig 6. Transverse Section



edge railways are to be seated and fastened, and which chairs are to be firmly bedded and spiked down upon stone blocks, or upon wooden sleepers, or cross bearers, in the manner now usually practised for the ordinary chairs of edge railways; and the object of my said improvement is to provide firm and secure bearings at the bottoms of the notches in the chairs for the rails to rest upon, those bearings being capable of self-adjustment, in order that they may adapt themselves correctly to the under parts of the rails; and adequate provisions being also made for fastening the iron rails securely downwards upon such self-adjusting bearings, as well as for confining the rails laterally within the notches in the chairs, but in such manner that the said self-adjusting bearings will not be subject to be deranged, nor the said fastenings to be loosened, by the effect of any such slight tilting or inclination of the chairs in the direction of the length of the rails as may result from partial or unequal subsidence of the ground beneath the stone blocks or wood sleepers, upon which the chairs are fastened, nor by the effect of any such slight elongations and contractions in the length of the rails as they are usually liable to from ordinary changes of temperature. And my said improvement consists in the application of a self-adjusting segmental bearing-piece into a suitable cell at the lower part or bottom of the notch in each chair, in order to form a bearing-surface for the rail to rest upon, the said segmental bearing-piece being in the form of a segment of a circle, and lodged with its convexity or circular arch of the segment downwards within the cell, which is of corresponding concavity, and excavated below the usual level of the bottom of the notch in the chair, the flat side or chord of the said segment being uppermost, and forming the bearing-surface at the bottom of the notch in the chair; upon that bearing-surface the under-side of the iron rail is to rest, and the said bearing-surface will always accommodate itself to the said under-side of the rail, so as

to form an even contact therewith, in consequence of the lower convex part of the segmental bearing-piece assuming a suitable position within its cell, whereby the said uppermost or rail bearing-surface of the said segmental bearing-piece will always preserve its conformity to the under-side of the rail, although the chair itself in which the said bearing-piece is applied, should come to tilt or incline in the direction of the length of the rail in consequence of unequal settlement of the ground in which the stone block or the sleeper is bedded. And in order to fasten the rails securely downwards upon my said segmental bearing-pieces, as well as to confine the rails laterally within the notch of each of the chairs, the parts with which each chair is provided for the purpose of such fastening, must take its (or their) hold of the rail (or of the rails) at or very near to the centre of the circular curvature of the said segmental bearing-piece, and of the cell wherein the same is lodged, because a settlement or tilting of the chair, and the corresponding self-adjustment of the segmental bearing-piece in its cell, as aforesaid, will not have any material tendency to loosen or interfere with the holding-down action when the same is applied at or very near to the centre, about which the motion attendant on the said self-adjustment will take place. And further, the said holding-down action which is to be applied, as aforesaid, by taking hold of the rail or rails at or near to the said centre, must take that hold in such manner as will permit of slight elongation and contraction of the rail or rails, in the direction of their length, without relaxing the effort of the holding-down action, or displacing the point of action thereof away from the said centre. And likewise the same parts which perform the holding down must effect the lateral confinement of the rails within the notches of the chairs, and must also retain the rails edge-ways upwards, in a proper position for the wheels of railway carriages or of locomotive steam-engines to travel upon them. The mode of holding down

and fastening the rails upon my said segmental bearing-pieces, which I recommend for the fulfilment of the aforesaid conditions, is by the application of cylindrical centre-pins of iron, which are fitted into corresponding sockets formed through the cheeks or sides of the notches of the chairs, so as to be firmly held in a horizontal direction or nearly horizontal, and cross-ways to the direction of the length of the rails, and which cylindrical pins terminate with obtuse conical points at those ends which project from the sockets into the notches of the chairs, and the said points enter into oblong or grooved recesses, which are formed in the upright sides of the under part of the rails, suitably for the reception of the said points, the oblong elongation of the said grooved recesses being in a longitudinal direction along the rails, each of the said cylindrical pins is transfixed by a tapering or wedge-like key, which is inserted horizontally through a suitable mortice opening in the cheek or side of the chair, so as also to pass cross-ways through a suitable mortice opening across the cylindrical pin, at right angles to the length thereof, and in a direction parallel to the length of the iron rails. The said tapering key being so applied in its mortices through the cheek of the chair and through the cylindrical pin, that when the key is driven in through its mortices, the cylindrical pin will be forced forwards end-ways with its conical end or point in contact with the rail, in consequence of the tapering form of the wedge-like key, and the conical end of the cylindrical pin being by that means forced into the aforesaid grooved recess in the rail, that conical end will bear on the lower part of that recess, with an oblique bearing-down action, which will jamb the rail downwards upon its self-adjusting bearing-piece at the same time that it confines the rail laterally within the notch of the chair. And note—those chairs which are to receive and support the extremities of the several lengths of iron rails at the junctions of those extremities, require to be provided with

two of the aforesaid cylindrical pins and wedge keys, in each chair, viz., one cylindrical pin through each cheek or side of the notch in the chair, with the conical points of those pins directed towards each other. The extremities of the lengths of iron rails may be united by what are called scarf or half-lap joints, which apply flatwise to each other, side by side; and the double, or over-lapping parts, at the ends of two adjoining rails, being included within the notch in the same chair, the conical points of the two opposite pins of that chair are both to be forced forwards, by their respective wedge-like keys, into the grooved recesses aforesaid, which are made at the outside of each the two halves of the half-lap or scarf joint, by which means the pressure occasioned by the wedging up of the two pins, will hold the said two halves firmly together, at the same time that the action of each of the conical points of the pins within its own grooved recess in one half of the joint of the rails, will hold that half down upon my segmental bearing-piece, which is applied as aforesaid, in its cell, at the bottom of the notch in the chair, for the ends of the two rails to act upon, wherefore by the keying of the two opposite pins of the same chair the junction of two rails is made secure laterally, and also the extremity of each of those two rails which form the junction, is fastened downwards, independently of the fastening down of the extremity of its fellow rail, in the same chair, and on the same segmental bearing-piece at the bottom of the notch of that chair. But those chairs which are to form the intermediate supports for the several lengths of iron rails, between the junctions of those lengths, require only one of the said cylindrical pins in each chair, viz. through one of the sides or cheeks of the notch of the chair, the opposite side or cheek being a flat vertical surface (or nearly so) against which the flat vertical surface of the iron rail is pressed laterally, and held firm thereto, by the keying up of the cylindrical pin through that cheek or side of the notch of

the chair to which the said flat vertical surface is opposite, and at the same time the action of the conical point of the cylindrical pin, in its grooved recess in the rail, holds the rail forcibly downwards upon my segmental bearing-piece, which is applied in its cell, as aforesaid, at the bottom of the notch of the chair for the underside of the rail to rest upon. The said intermediate chairs, with one cylindrical pin in each chair, by holding the rails laterally against the flat vertical side or cheek thereof, as above mentioned, will keep the rails edgeways upwards and firmly retained in their proper positions for the wheels of railway carriages and locomotive steam-engines to travel over them. The other kind of chairs hereinbefore mentioned, with two cylindrical pins in each chair, confine the junctions of the several lengths of iron rails together laterally, at the same time that they hold down the extremity of each rail on my segmental bearing-piece. The grooved recesses which are formed in the sides of the iron rails for the reception of the conical points of the cylindrical pins, and for giving them their oblique bearing-down action, being of an oblong form, in the direction of the length of the rails, as aforesaid, that form will permit of slight elongations or contractions of the rails lengthwise, without causing any relaxation or alteration in the confinement of the rails in their chairs, because elongations and contractions will have no influence on the lateral pressure which the said conical points are required to exert against the rails, nor on the holding-down action which results from the same lateral pressure, in consequence of the oblique bearing-down action of the conical points against the lower part of the grooved recesses in the sides of the rails. And in consequence of the centre of the said conical points being at or very near to the centre of the circular curvature of the cell at the bottom of the notch in the chair (and of my segmental bearing-piece, which is lodged in that cell), any slight tilting or inclination of the chain in the direction of the

length of the rails and consequent self-adjustment of the said segmental bearing-piece in its cell, will not cause any relaxation of the confinement of the rails in their chairs, because such tilting will have no influence either on the lateral action of the conical points, or on the holding-down action, which results therefrom, by oblique action of the said conical points in the grooved recesses in the rails. And note—in lieu of mere conical points to the said cylindrical-pins, the latter may terminate with obtuse wedge-like or chissel ends, adapted to enter into and act obliquely within the aforesaid oblong grooved recesses in the rails, in which case the cylindrical pins must be allowed a small liberty of turning-motion in their sockets, through the sides or cheeks of the chairs, in order that their chissel ends may continue to conform to the grooved recesses in the rails, notwithstanding any slight tilting of the chairs themselves. For this purpose the mortices through the cylindrical pins must be as much wider than the thickness of the wedge-like keys which are to be driven through the said mortices as will permit of the requisite turning-motion of the cylindrical pins in their sockets. And the acting extremities of the said cylindrical-pins, whether conical points or chissel ends, may be case-hardened, or they may be made of steel, hardened and tempered, in order to give them durability if required. And note—the sockets for the said cylindrical pins may be made through the cheeks or sides of the chairs, in a direction somewhat inclining from the horizontal, instead of being horizontal, as hereinbefore mentioned, the conical or chissel-shaped ends of the pins being rather lower than the other ends, in order that the lateral action and pressure exerted by the pins, may act against the rails with a downwards tendency when the pins are forced endways by their cross-keys into the grooved recesses in the rails. The holding-down action on the rails, will be rather greater if the pins are so inclined, than if the pins are horizontal, but their inclina-

tion from the horizontal must not be so great as to cause any sensible impediment to the turning-action, which the conical points of the pins must make within the grooved recesses in the rails, or else the turning-motion which the chissel-ended pins must make in their sockets, in order to accommodate to a tilting inclination of the chairs. And for the more complete explanation of the manner of carrying my said improvement into effect, I have hereunto annexed two sheets of drawings, which exhibit two chairs for supporting the iron rails of edge railways, when the same are constructed according to my said improvement.

Fig. 1, in sheet I., is a perspective view; and in sheet II., fig. 2, is a lateral elevation.

Fig. 3, a transverse section; and

Fig. 4, a horizontal plan of a chair, for supporting and uniting the extremities of the lengths of iron rails for edge railways. A, A, is the flat bottom or base of the chair, which is to be bedded upon the stone block or wooden sleeper, and firmly fastened thereto by spikes driven down through the holes, *a, a*. B, B, are the cheeks or sides of the notch in the chair, that notch being the parallel space which is left between the said cheeks or sides for the reception of the rails C, *c*, D, *d*, which may join together with a half-lap joint, as is shewn in the perspective view, fig. 1, and in the plan, fig. 4, the double or overlapping parts, *c, d*, being of the same size, or nearly of the same size, as the other parts of the rails, and those parts are included within the notch of the chair. The bottom of the said notch is deeper than necessary for receiving the rails, and is depressed into a concavity or cell suitable for the reception of my segmental bearing-piece, 4; see also fig. 1, where the same is represented separately; the under edges of the rails rest upon the uppermost flat surface of the said bearing-piece, 4, the undermost part of which is a circular curve, and the form of the cell corresponds thereto.

5 and 6, are the cylindrical pins, which are fitted into cylindrical sockets, through each of the cheeks or sides. B, B, and 8, 9, are the tapering or wedge-like keys, which are inserted through suitable mortices in the cheeks, and across the pins 5 and 6, for the purpose of forcing forwards those pins, so that their pointed extremities may press obliquely upon the lower parts of the grooved recesses in the rails, with a bearing-down action, which will confine the rails downwards upon the bearing-piece, 5, at the same time that they are confined laterally in the chair. The cylindrical pins, represented in figs. 1, 2, 3, and 4, are in an inclined direction, in order that their bearing-down action may be more efficient, but the pins may be horizontal; in either case the centre of curvature of their points, at the places where those points bear in the grooved recesses of the rails, being at, or very near to, the centre of curvature of the lower part of my segmental bearing-piece, and of the cell in which it is lodged. In fig. 1, the cylindrical pins are shewn detached, in order to explain the manner in which the pointed extremity applies into the grooved recess in the rails, so as to exert a bearing-down action thereon; and in the same fig. 1, a chissel-end is represented, as well as a conical point.

Fig. 5, sheet I., is a perspective view; and

Fig. 6, sheet II., is a transverse section of a chair for supporting the iron rails at intermediate distances between the extremities or junctions of their several lengths; it has only one cylindrical pin, 5, fitted through one of its cheeks, B, the opposite cheek, K, being a flat vertical surface against which the flat side of the rail is pressed and held firm, by the keying up of the cylindrical pin, 5, so as to confine the rail laterally at the same time that the oblique action of the point of the cylindrical pin, 5, in the grooved recess in the rail, produces a bearing-down action, which confines the rail down upon my segmental bearing-piece, 4, which is

applied in a cell at the bottom of the notch of the chair, exactly the same as in the chair with two cylindrical pins, before described. The chairs are to be made of cast-iron; the sockets for the cylindrical pins, the mortices for their wedge-like keys, and the cells for my segmental bearing-pieces, being all formed in the casting, as well as the holes for the holding-down spikes. The wedge-like cross keys, the cylindrical pins, and the segmental bearing-pieces, are to be made of wrought-iron.

Having now described the nature of my said improvement, and the manner in which the same is to be performed, I, the said Robert Stephenson the younger, do hereby declare that the new invention whereof the exclusive use is granted to me by the aforesaid letters patent, consists in the mode hereinbefore described of supporting the iron rails for edge railways upon a segmental bearing-piece, which is lodged in a suitable cell, at the bottom of the notch in each chair, the rail being confined downwards on such bearing-piece, by the same force of keying action, which also confines the rail laterally in the chair, and the action or pressure which produces such confinement, being applied at or very near to the centre of curvature of the said segmental bearing-piece, and of the cell wherein the same is lodged, in order that the supporting and confinement of the rails may not be disturbed or relaxed by a slight tilting or inclination of the chair in the direction of the length of the rails, as hereinbefore explained. And as to the mode hereinbefore described of producing the requisite confinement of the rails in the chairs, by means of wedge-like cross keys and cylindrical pins applied in suitable sockets through the cheeks or sides of the chairs, and by forcing the pointed extremities of those pins into oblong grooved recesses in the rails, so as to exert an oblique bearing-down action on the rails, by the same force of keying, which produces the lateral confinement of the rails in the manner hereinbefore described: I wish to be understood,

that although the said mode of producing the requisite confinement was invented by me, yet the same was brought into use (but without my segmental bearing-pieces for supporting the rails) some months before the date of the said letters patent, wherefore I do not make claim to the exclusive use of the said mode, unless my segmental bearing-pieces are used in concert therewith, for supporting the iron rails of edge railways.—In witness whereof, &c.

Enrolled June 11, 1834.

Specification of the Patent granted to Elijah Galloway, *of Carter Street, Walworth, in the County of Surrey, Engineer, for Improvements in Steam-Engines and Apparatus for Propelling.*—Sealed November 7, 1832.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Elijah Galloway, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

My invention consists, first, in improvements in steam-engines particularly intended for marine purposes, such improvements consisting of having three piston-rods to one steam-cylinder, two of which rods are intended to communicate the power from the piston to the main shaft which drives the paddle-wheels, and the third rod is to work the air-pump of the condenser, as will be fully described hereafter. Secondly, my invention consists in improvements in paddle-wheels or apparatus for propelling vessels, such improvements being the placing of

Plate XIII Vol II New Series.

Galloway's Patent

Fig . 1 .

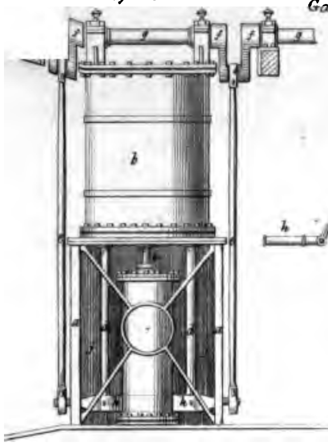


Fig . 2

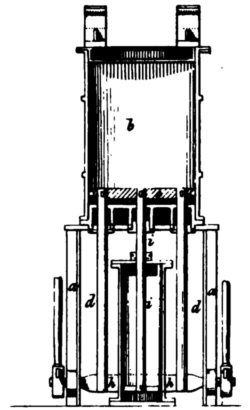


Fig . 3

Fig . 4 .

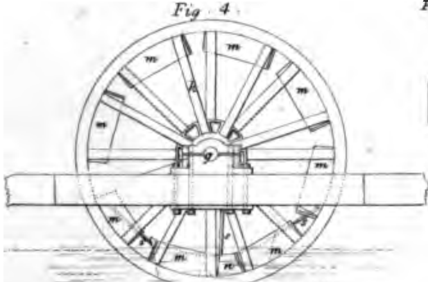


Fig . 7 .

Fig . 5 .

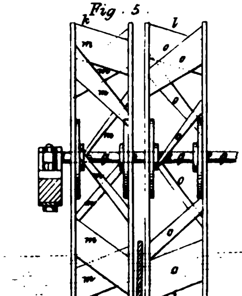
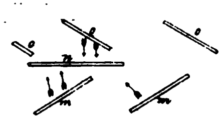


Fig . 6 .



Boys'. Patent

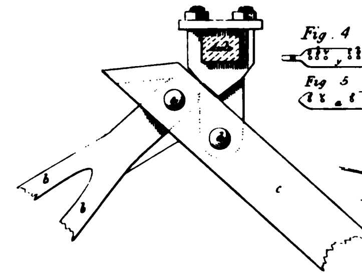


Fig . 4

Fig 5

Fig . 1 .

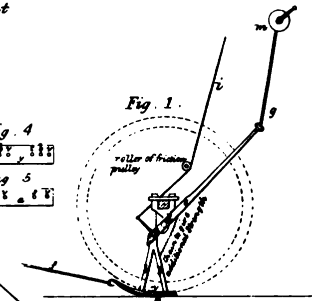
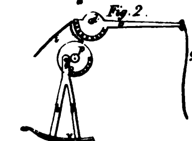


Fig. 2 .



Boynton's Patent

Fig 1 .

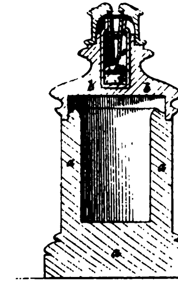
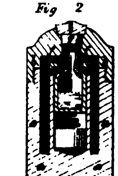


Fig 4

Fig 3

Fig 2



two sets of paddles side by side, the float-boards or paddles being set at an angle to the shaft, and also at an angle to each other, such float-boards not standing opposite each other, but are equi-distant, and consequently enter and leave the water in succession: between these two paddle-wheels is placed what I call a dividing-plate or board, which is intended to prevent the water being forced laterally, as will be fully described hereafter: by this means such float-boards or paddles will always enter and leave the water at an angle, thus preventing any concussion at their entrance into the water: and also such float-boards or paddles will not lift the water on their leaving it, as is the case with the common paddle-wheels, and by means of the dividing-plate or board the water will be prevented moving laterally away from the float-boards, and thus will the float-boards have as full action on the water, as if they were in a line with the shaft, but so soon as the float-boards pass the end of the dividing-plate or board, they will only offer their angular surfaces to the water, and glide easily out therefrom without lifting it. In order that my invention may be fully described and understood I will now describe the drawings hereunto annexed.

Description of the Drawing.

Fig. 1, represents an elevation of some of the principal parts of an engine constructed according to my improvements;

Fig. 2, being a section of some of the parts; and

Fig 3, is a plan of the cross-head: in each of these figures the same letters indicate similar parts, *a*, being the framing which supports the engine. *b*, is the steam-cylinder. *c*, the piston. *d*, *d*, the two piston-rods (passing through the stuffing-boxes constructed on the lower cover of the cylinder), which communicates the power of the steam by means of the connecting-rods, *e*, *e*, to the cranks, *f*, *f*, of the main shafts, *g*, as is clearly

shewn in the drawing. These two piston-rods, *d, d*, are connected by the cross-head, *h*, shewn separately in fig. 3, where it will be seen that the cross-head is bent or curved so as to embrace the air-pump, and thus be free to move up and down. *i*, is the third piston-rod, which works the air-pump of the condenser, *j*. The construction of the various parts of a steam-engine is so well understood by engineers, that it will not be required here to go into any further description of the other working parts connected to the steam-cylinder, they forming no part of my invention, and more particularly as they are not varied from ordinary steam-engines. The object of having the three piston-rods, is, to admit of the air-pump being brought immediately under the cylinder, and to be worked by one of the piston-rods, whilst the placing of the air-pump does not lengthen the other piston-rods, and, consequently, does not increase the height of the engine, on account of the cross-head being curved or embracing the air-pump, and being permitted to work up and down without interfering therewith: by this arrangement, many of the moving parts heretofore employed in marine-engines will be got rid of, and a considerable saving of space and weight will be obtained, and in consequence of the peculiar arrangement of the float-boards and apparatus of the paddle-wheels, when constructed according to the second part of my invention, these engine are to be used as single engines: for, owing to these paddle-wheels not being so liable to be struck back by any description of sea, they will at all times act as fly-wheels to the engine, and thus render two engines unnecessary.

I will now describe my improvements on paddle-wheels or apparatus for propelling.

Fig. 4, shews a side-view of a paddle-wheel, constructed according to my invention.

Fig. 5, is a front-view thereof.

Fig. 6, represents the action of the float-boards and

their position one to the other, when they are under the water, the dividing-board or plate being shewn between them and the arrows in this last figure, shews the tendency of the water as it would be forced inwards to the middle of the wheel and out of the way of the float-boards, if the dividing-board or plate did not prevent such lateral motion of the water till the float-boards have passed the dividing-board or plate. In these figures, *g*, being the main shaft; *k*, and *l*, are the two wheels affixed on this shaft, the float-boards on the wheel, *k*, being marked by the letter *m*, and the float-boards on the wheel, *l*, being marked by the letter *o*. It will be seen in fig. 5, that the rims of the two wheels are not brought close together, but that there is a small space between them; this is in order to allow of the compound wheel turning freely, and yet at the same time admitting the dividing-plate or board between them. *n*, is the dividing-plate or board, which is securely affixed and held stationary between the two wheels by the bars or rods, *s*, fig. 4, as is shewn in the drawing: this dividing-plate extends to about one-eighth of the circumference of the wheels, and, as above described, is intended to prevent the water being forced laterally from the float-boards, *m, o*, till they pass the end of the dividing-board, *n*: thus it will be evident, that the float-boards, during the time the water is so restrained from lateral motion, will act as powerfully as if they were in a line with the shaft, *i*; yet, at the same time, when the float-boards pass the end of the dividing-plate, *n*, they will no longer hold the water, but will force it laterally and come smoothly out of the water without raising the same, and thus will the back water, heretofore so much complained of, be got rid of, and the paddles entering the water at an angle will avoid those concussions to which the common paddle-wheels are subject, and which are so prejudicial to the stability of the vessel and also to the machinery. In place of having two separate wheels the middle spokes

or arms may be made forked, as shewn in fig. 7, leaving sufficient space between the paddle-boards for the dividing-plate, as before described.

Having now described the nature of my invention, and the manner of constructing the same, it will be evident that it is to be understood that one of these compound wheels is to be placed on each side of the vessel, in like manner to the ordinary paddle-wheels. And I would observe, that I am aware that paddle-wheels have been before used, having the float-boards set at an angle to the shaft; I do not, therefore, lay any claim to using angular paddles or float-boards; neither do I claim any of the various parts of which the steam-engine above described is composed, they being separately well known and in use: but what I claim as my invention is, first, the constructing marine steam-engines having three piston-rods, two of which communicate the power of the steam acting on the piston to the shaft, as above described, and the other works the air-pump; and, secondly, the constructing of paddle-wheels, having the paddle-boards set at an angle to each other, and having a dividing-board or plate to prevent the water being forced laterally so long as the float-boards are intended to be in action, as above described.—In witness whereof, &c.

Enrolled May 7, 1833.

Specification of the Patent granted to Edward Boys, *junior, of Rochester, in the County of Kent, Gentleman, for a Machine or Apparatus for Preventing Accidents with Carriages in descending Hills, or in other perilous Situations.*—Sealed April 4, 1833.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Edward Boys, do hereby declare that the

nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

My invention consists in applying certain arrangements of apparatus to the axle of various descriptions of carriages, whereby a person may be able to obtain a friction (similar to the skidding of a wheel), to retard the progress of the carriage, without the necessity of stopping the carriage for that purpose. And in order that my invention may be fully described and understood, I will proceed to describe the drawing hereunto annexed.

Description of the Drawing.

Fig. 1, shews an arrangement of my apparatus, as applied to a four-wheeled carriage, *a*, being a skid-pan of the form described in figs. 5 and 6, which is affixed to the base, *y*, on which rest the arms, *b*, *b*, which come together at the top, as shewn in the drawing. *c*, is a lever having its fulcrum at *d*, in a bearing which is affixed to the axle. To one end of the lever, *c*, is attached the descending-arms, *b*, *b*, by means of a bolt, *e*. To the base, *y*, which is bolted to the skid-pan, is attached the rod or chain, *f*, which is attached to any convenient part of the carriage, in like manner to the chain of the ordinary skid; but I prefer that the same should be so attached as to obtain a pull as nearly in a direct line with the skid as possible. *g*, is a strap or band affixed to one end of the lever, *c*, and connected with the roller or windlass, *m*; and from this roller, *m*, there is another strap or band, *i*, attached to the end of an arm that is fixed on the top of the arms, *b*, *b*, as shewn in the drawing. This roller, *m*, turns on a pin affixed to the hind part of the carriage, and may be actuated by any person sitting near it; or in place of the roller, *m*, being

fixed behind the carriage, it may be fixed conveniently for the driver; in this case the straps, *g*, and *i*, may be conducted over small rollers to the roller, *m*, and if required, the same straps, *g*, and *i*, may be continued on to a windlass or roller affixed to the poll of the carriage, so as to be used by a postillion. It should be observed, that the roller, *m*, is of two diameters to suit the difference of the length which the strap, *g*, and *i*, have to pass through. Now it will be evident, that if it be desired to produce friction, and thus tend to retard the carriage in case of descending a hill or the running away of the horses, the guard or other person may, by turning the roller or windlass, *m*, bring the skid-pans on the arms, *b*, *b*, to press on the ground, thereby raising the wheel gradually from the ground, and thus produce a similar friction as the placing a skid-pan under one of the wheels: and when it will be required to remove the friction, then all that will be necessary will be to turn the roller, *m*, in the opposite direction, and the skid-pan, *a*, will be raised off the ground, and the wheel will again rotate upon the ground. If this machine or apparatus were affixed to the axle, on the outside of the hind wheels instead of within, a greater degree of safety would be preserved by reason of two of the points of pressure of the carriage being extended to a greater width from each other: but I am aware also, that in these cases some attention is necessary to be paid to appearances.

Fig. 2, is another arrangement differing chiefly in the manner of combining the lever, *c*, and the descending-arms, *b*, *b*. In this instance the lever, *c*, stands at right angles with the wheel, in place of being parallel with it. The lever, *c*, has its fulcrum at *d*, and turns horizontally thereon: at one end is formed a toothed rack, which takes into the teeth formed on the circular-plate, *p*, which turns freely on the axle of the wheel, the descending-arms, *b*, *b*, being attached to this plate by a pin, as shewn. *g*, is a chain or link connected to the plate, *p*,

and to the lever, *c*. Now if similar straps, *g*, *i*, be attached, as before described, to the other end of the lever, *c*, and connect with a roller, *m*, or otherwise, it will be evident that by the moving the lever, *c*, a similar result would be effected as in fig. 1, that is, the wheel may be raised from the ground, and the skid-pan may be lowered down, or the wheel may be lowered to the ground, and the skid-pan raised up, as required, without stopping the carriage. In fig. 1, the lever may be arranged either with an upwards or downwards pull or action, as is most convenient to the form of carriage to which it is applied. And as a further means of guarding against accidents, in case of the horses running away, and to give an additional friction, I would recommend that the arms, *b*, *b*, with a similar base, pan, and rod, but without the lever, *c*, be suspended from the axle of the opposite hind wheel, the radius of which machine (measuring from the axle to the base) is somewhat greater than the wheel. If this be hooked up from the ground, to a convenient height, by a chain, strap, or cord, it will only be necessary, when required to use the same, to release the strap, and that side of the coach, together with the adjacent wheel, will be immediately raised from the ground to a height equal to the difference between the shoed arms and that of the wheel; but in this instance the carriage must be stopped and backed off, as in ordinary cases, to release the skid. I would recommend, also, that the horses be at all times somewhat checked in their speed at the moment of skidding, in order that the action may not be too sudden to cause the rod or chain to break.

What I claim, is, the combining and affixing the common jack or lever-movement, *b*, *b*, and *c*, having the skid or shoe, *a*, as above described, and actuated by the bands or straps connected with a windlass or roller, to be fixed at any convenient position of the carriage where it may be desired to be acted on, either by the guard behind, the coachman in front, or by others in the carriage, or by

the postillion, having in that case the roller affixed to the pole, depending only on the position of the roller or windlass.—In witness whereof, &c.

Enrolled October 4, 1833.

Specification of the Patent granted to James Boynton, *of High Holborn, in the County of Middlesex, Portable Inkstand Manufacturer, for Improvements in Apparatus or Means of producing Instantaneous Light.*—Sealed January 18, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said James Boynton, do hereby declare the nature of my invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

In ordinary apparatus or means of producing instantaneous light, by dipping a match into acid, it is well known that when the cover or stopper of the bottle or vessel containing the acid is left off for any length of time, the effective property of the acid is quickly destroyed by the action of the atmosphere, and from the well known destructive properties of the acid on most substances, it is desirable to use a substance as a stopper or cover which is not prejudicially acted on by the acid. Now my invention is intended to obviate both these objections to the ordinary apparatus or means for producing instantaneous light wherein acid is used; and my improvements consist, first, in the application of quicksilver as a covering to the acid for the purposes of excluding the action of the atmosphere from destroying the effective properties of the acid, at the time of the bottle

or other vessel being left unstopped or uncovered. Secondly, in the application of talc as a covering or stopper to the bottle or vessel containing acid used for the purpose of producing instantaneous light. But in order that my invention may be most fully described and ascertained, I will describe the drawing hereunto annexed.

Description of the Drawing.

Fig. 1, represents an apparatus for producing instantaneous light, *a*, being a box shewn in section, and *b*, the cover. This box is intended to contain a supply of the ordinary matches. On the top of the cover, *b*, is inserted the bottle, *c*, containing the acid. Into the mouth of this bottle, *c*, is inserted and cemented the tube, *d*, for the purpose of preventing the quicksilver from flowing out in the event of the apparatus being turned over. *e*, represents the quicksilver which lies on the top of the asbestus which contains the acid. By this it will be evident that the atmosphere will not be able to come in contact with the acid, by which means its properties will be preserved for a very considerable length of time, even though the cover or stopper be left off the bottle or vessel. In using this apparatus the match is to be dipped quickly through the quicksilver and hastily withdrawn, the quicksilver flowing back and again covering the acid as the match is removed, and thus preventing the atmosphere acting on the acid.

Fig. 2, represents my second improvement, in which figure the same letters of reference indicate similar parts, it will not, therefore, be necessary to again describe them, but I will confine myself to describing, in the present figure, the application of talc as a cover or stopper to the bottle. *f*, fig. 3, is a disc of talc which is affixed at that part of the top of the cover, *b*, which comes in contact with the mouth of the bottle or vessel containing the acid, the bottle being constantly pressed upwards by the spring, *h*.

Fig. 4, represents a disc of foil or thin metal which is placed on the talc. *g*, is a piece of cork which forms an elastic back to the talc cover or stopper. In figure 2, the blue line represent the talc, and the yellow line the metal.

Having now described the nature of my invention, and the manner of carrying the same into effect, I would observe that I lay no claim to any of the parts in their separate condition; and I would have it understood, that I do not confine myself to the design or shape of the boxes shewn and described, as it will be evident that they may be formed into a great variety of devices; at the same time as they constitute no part of my invention, no further description will be necessary: and I would have it understood, that I do hereby confine my claim of invention, first, to the application of quicksilver as a covering to the acid, for the purpose of excluding the action of the atmosphere from destroying the effective properties of the acid when used for the purpose of producing instantaneous light. Secondly, the application of talc as a cover or stopper to bottles or vessels containing acid, when used for the purpose of producing instantaneous light, as above described.—In witness whereof, &c.

Enrolled July 18, 1834.

ORIGINAL AND SELECTED PAPERS.

Mr. W. Hancock's Steam-Carriages.

TO THE EDITOR, &c.*

Sir,

Any unprejudiced person, particularly if a lover of science, and having any regard for the welfare of his

* We have great pleasure in giving insertion to this communication. Making some allowance for the enthusiastic feeling expressed, we agree

country, can but view with satisfaction and pleasure, the performance of *Mr. Walter Hancock's steam-carriages,* now running between London and Paddington; and no doubt Mr. H. must feel highly gratified, at having, after a continued toil of *eight years,* brought to perfection and public approval, these self-acting machines.

If the subject was one of mere shew or idle speculation, instead of actual national benefit, we could but admire his zeal for the completion of his object, and his determined spirit, amidst all the oppositions and difficulties thrown in his way to embarrass his laudable career.

The pretenders to science have, on paper, written that to be impossible, which the head and the hands of *Walter Hancock* have given denial to, in a less perishable form.

Following the great *Bacon* of old, he has preferred actual experiment to doubtful theory, and thus progressing, has accomplished his work. I have watched his *labours year by year,* and know that any reward which may now await him, cannot be too great for them.

At the first proposal of steam locomotion on common roads, the tone of the public mind did not harmonize with it; indeed, to the present moment there are men, with the knowledge that carriages are actually running, who affect to doubt even its practicability; and what may appear equally strange, is the fact that eminent engineers, who formerly entertained similar opinions, are now actually (if I may borrow the phrase) *compiling* a carriage from the experimental materials, furnished by the labour and at the cost of those they would have had the world despise. They have escaped the insults and the scoff and ridicule of their leaders, and are now for sliding in to share their merits and emoluments.*

with the writer, that Mr. Hancock deserves great credit for his perseverance and talent, and we heartily wish him success.—EDITOR.

* This circumstance is not fairly stated. We are in possession of the facts, and it is but justice to the gentlemen here pointed at, that the truth should be given. The carriage our correspondent refers to as being "*compiled*" we have no doubt is the one now building at Messrs. Maudslay,

The greatest and the most dreaded obstacle, was that of ascending hills. Calculations upon traction have been made, and devices have been planned, by mechanics, to

Sons, and Field's factory. The circumstances which induced these gentlemen to engage in this undertaking, are as follows:—Sir Charles Dance (than whom, both by his purse and his talent, no one has done more to the advancement of locomotive carriages on common roads), by very extensive experiments at Gloucester, and afterwards at Stanmore, with some carriages constructed by Mr. Gurney and improved by himself, had fully ascertained the practicability of running steam-coaches on the ordinary roads, at the same time he made himself acquainted with the necessity of more practical men than himself pursuing the alterations and the improvements which practice had pointed out. This induced him to apply to Mr. Field, and that gentleman advised that the old carriage should be slightly altered in order to allow of the application of a newly arranged tubular boiler, for which Sir C. Dance and Mr. Field jointly obtained a patent. The result of these alterations was the first practical journey (of any extent) being run to Brighton and back without the slightest derangement, notwithstanding the carriage was old and had been cut and carved in every direction (see Repertory, vol. xvi., third series, p. 241). The same carriage afterwards continued to run for some time to Greenwich (see Repertory, vol. xvi., third series, p. 297). In one of which journeys Mr. Telford accompanied the carriage, and was satisfied of the possibility of steam-carriages being advantageously used on common roads provided the roads were suitably hard and well made. A meeting of several highly respectable engineers took place, Mr. Telford at their head; it was determined that Sir C. Dance had done enough as a private individual, and deserved well of his country; these gentlemen solicited that the carriage should at their expense be run to Birmingham further to test its capability, the result of which is well known (see Repertory, vol. xvi., third series, p. 369). A company was formed for improving the roads between London and Holyhead for steam-carriages, and a carriage was ordered of Messrs. Maudslays and Field, according to the improvements before mentioned, which will shortly be completed. We would remark that it is not to be expected, nor is it often the case, that men of extensive practice are the parties to be looked to for first bringing about new inventions, their occupations seldom admitting of their dedicating sufficient time: but when a private individual, as Sir C. Dance or Mr. Hancock, has gone to a certain extent in maturing an invention, and some of the most practical and talented engineers come forward, unsolicited, to assist him in completing his work, such conduct is most honourable and praiseworthy, deserving the highest commendation; and in place of their taking merit or emolument from the inventors, they have, by their report *, advanced the

* For Report of the Engineers, see Repertory, vol. xvi., third series, p. 373.

overcome this visionary impediment; but they may now regret the loss of their labours, as by the power contained within the carriages themselves (and not by additional, costly, and cumbersome mechanical appendages) they may daily see the "Infant," the "Autopsy," or the "Era," loaded with passengers, ascending the badly kept road of Pentonville hill.

It is worthy of remark, that the beautiful and commodious carriage, the "Era," was not expected to ascend that hill at a greater speed than six miles, but it generally performs at the rate of eight miles in its worst, and ten miles in its better parts, whilst on the level road it will maintain 16 miles per hour.

As a proof of its power, a few days back a small pin dropped out of some of the machinery of the "Autopsy," by which it was brought to a stand; the "Era" was fetched out, and with great ease towed the "Autopsy" (whose weight is supposed to be three and a half tons) to the station in the City Road, performing up Pentonville hill at the rate of five miles per hour.

Mr. Hancock commenced his experiments in the year 1826, by constructing the carriage now called the "Infant," but the form and arrangement of the machinery of it where then very different to what they now are. Mr. H. frequently run it out in the neighbourhood of his factory, at Stratford, and, on each return, minutely examined its works, and discovering their defects, either altered and improved those already in use, or invented and substituted parts to replace them.

In constructing his boiler, he first tried various combinations of tubes, a mode which in theory appeared to possess advantages, and had been the favourite one of several engineers, yet in practice, being dissatisfied with every modification of tubes, he gave them up. Having,

opinion of the country in favour of locomotive carriages on common roads, and have risked well-earned fame by staking their credit on the probable result.—EDITOR.

however, by this practice, discovered the *requisites* of a boiler adapted for steam locomotion, he set his inventive mind to work, and the result was his present boiler, which consists of a series of thin parallel chambers, placed vertically, with narrow spaces between each chamber for the play of the fire: the chambers are, by a singular and very effective contrivance, all connected with each other near the top and bottom, and are prevented distending by a number of vertical bars, placed up between them, or by projecting hemispheres in the side of each chamber, and the whole tied together by immensely strong bolts and braces.

After securing his invention by a patent, and now possessing the grand stamina of a steam-carriage, namely a boiler which is cheap in its construction, of little weight, not subject to leakage, an economist of fuel, and which generates dry steam very rapidly, he continued his experimental trips with greater confidence and increased expectations of ultimate success, and by the year 1831, after having spent five years of the prime of life, in unwearied application, and most likely expended as many thousand pounds, not one farthing of which had been supplied from any public source, he found himself in a situation to offer his invention to his country; this was to him a most unpleasant task, for throughout his experimental career, with the exception of his private circle of friends, no individual was ever less supported; he was sneered at by the pretenders to science, derided by the press, and pitied by the benevolent as a mechanical enthusiast,—these where his fire-side comforts; when out, insulted, and his way impeded by coach-masters or their men, by horse-dealers, corn-dealers, and all who conceived their interests in jeopardy, although at the same time they all declared steam-coaches never could be brought into use. This appears somewhat paradoxical, but the perversion in the minds of some men cannot be accounted for.

The first company formed to run his coaches was the Brighton: for this company he built the "Era" (not the one now running to Paddington): with the exception of a few trial trips, twice to Windsor, &c., it has never worked, I believe, and is now waiting the determination of the proprietors.

In the year 1832, the Paddington company was formed, and a carriage to be called the "Demonstration," afterwards altered to the "Enterprise," was finished, and run the London and Paddington road for sixteen successive days, on hire, in the month of April and May, 1833. Mr. Hancock having performed this part of his contract with the company, delivered the carriage to them, and was for proceeding, without further delay, to execute the two others, according to agreement; instead of which the "Enterprise" has now been kept shut up sixteen months. During all this time, an engineer, who has his friends amongst the company, has been building one on the same premises where the "Enterprise" stands, and which has, for all this long period, filled the honourable post of dumb instructor.

The treatment which Mr. Hancock had now received, after seven years' exertions, would have induced many men to abandon their object altogether as an unlucky one; not so with him,—instead of following and submitting to the caprices and the treatment of this company, he determined to build for himself, and has now two carriages of his own, running on his own account, on the same road.

Like the gardener in the fable, he did not stop to repine at his loss; but, without delay, and with increased energy, set to work again. Since the "Enterprise," he he has built the "Autopsy," refitted the "Infant," built the new "Era," and has nearly completed another carriage not yet named, and has built a steam-drag for Mr. Voigtlander, of Vienna, which was shipped last July.

The "Infant" was the first steam-carriage that passed

through the city by steam, or that ever was at Brighton; it run there, from Stratford, twice during the autumn of 1832.

The "Autopsy" also steamed through the city in the middle of the day, on its return from Brighton, on the 10th of October, 1833.

In November, 1833, the "Autopsy" run for three weeks, on hire, between Finsbury Square and Pentonville; but as it divided Mr. Hancock's attention from his carriages then in progress at Statford, he withdrew it.

Since then, Mr. H. has fitted up a station on the City Road, and made the necessary arrangements for a supply of water; and from here his carriages first commenced their now regular run from the city to Paddington and back, on Monday morning, the 18th of August last, and has now been running daily more than two months, and conveyed upwards of 4000 passengers at the usual omnibus fare of six-pence each. Steam-carriages have some claim upon the attention of the political economist, especially when it can be proved that they will afford an acession of manual labour, far above that of the present system.

The only drawback upon manual labour in a general view, would be in the repairs of roads, for as steam-carriages run with a wide flat tire, they will consolidate and improve a road, whilst the narrow tires of our present coaches, but, above all, the ploughing up and battering by the horses feet, quickly deteriorate it.

The accidents and loss of life so frequently occurring, by the horses of stage coaches becoming unmanageable, will be avoided by the adoption of steam-carriages; for it is impossible for anything to be under a more perfect controul,—they are to be steered with the greatest ease and precision, and stopped or started instantaneously at pleasure.

During Mr. Hancock's experimental progress, nothing annoyed him more than the magnitude and consequence

attached to any trifling failure, and which is generally allowed to be incident to any new mechanical invention. It has either been from enmity to, or jealousy of, a clever, persevering, plain-dealing, single-handed man; or those who have made so much of these matters, have acted in ignorance or forgetfulness, that the present stage coaches in this country, the race of horses by which they are drawn, with their harness and equipments, have been the work of ages—have engaged the attention of thousands of heads—at the cost of hundreds of thousands of pounds.

Does any one doubt what travelling probably once was in this country, let him travel others, let him visit almost the whole continent of civilized Europe, and I wish him safe back to England, however jolted and shaken, to hail it with pleasure and gratitude, as the hot-bed of genius and invention.

At the present day, it is not an unusual circumstance for a stage coach to have a trace broken or a splinter bar fail, but let an infant steam-carriage stop upon the road, although its damage is no greater, and repaired in equal time, and it would be published as a complete failure.

Should any theories of strength, and stress, and proportions, &c. of steam-carriages be published hereafter, let it be remembered that they have followed not preceded the practice.

There are many difficulties attendant upon land steam locomotion compared with fixed steam machinery or marine steam locomotion; for in many parts of these either weight or bulk is of little more consequence than cost of material; if a boiler is not powerful enough, make another plentifully capacious; if a framing or a shaft is to be constructed, never mind how strong it is made so that it is strong enough; but in a road steam-carriage, the great puzzle has been to get a powerful boiler in a small compass and of little weight, to have all parts of the machinery and framing strong enough, not too strong; in fact it is, that every ounce is an encumbrance and a

dead weight upon the wheels, and requires its ounce-worth of power to move it: to perform this, larger and consequently heavier machinery is required, which again adds weight upon the wheels, and a consequent enlargement of power is again required.

Giving this due attention, it will be seen, that by no ordinary arrangement, or such as is applied to any present fixed machinery or marine locomotion, can a steam-carriage work with any effect: in the first, neither space nor weight are of consequence; in the second, space may be considered more than weight, but in a steam-carriage space is very limited, and weight is of every consequence, because it is all dead upon its own resources; in fact, a road steam-carriage, on a level, but particularly up hill is a perfect self-acting machine; a steam vessel, is not so, because the path of its progress is in itself buoyant.

In conclusion, I hope that when the "Infant" has run its course,—and, long as it may be, that day will come,—it will not be broken up; but then, when I doubt not steam locomotion will have become general and all prejudices subsided, the "Infant" may be preserved in one of our national repositories of art.

Apologizing for the length of my letter,

I remain, Sir,

London, Your obedient servant,

Oct. 1834. A RETIRED TRADESMAN.

PROGRESS OF SCIENCE

APPLIED TO THE ARTS AND MANUFACTURES, TO COMMERCE, AND TO AGRICULTURE.

FURTHER ILLUSTRATIONS OF THE NATURE OF GLASS:—PROFESSOR TURNER'S EXPERIMENTS ON THE ACTION OF HIGH PRESSURE STEAM ON THAT SUBSTANCE AND ON OTHER SILICEOUS COMPOUNDS.—In our last volume (New Series, vol. i, p. 182; No.

for March, 1834), we gave, from the new edition of Parkes's Chemical Catechism, Mr. Brayley's summary of facts relative to the true nature of glass. The following is an abstract of a notice of some experiments recently made by Dr. Turner, Professor of Chemistry in the University of London, on the action of high-pressure steam on that and several other substances, which was read before the Geological Society on the 4th of June last. The facts it recites will serve further to illustrate the nature of glass and the circumstances of its decomposition. We shall probably return to the subject on a future occasion.

An opportunity having presented itself to the author of including substances in a high pressure steam-boiler, he took advantage of it to try the effect which would be produced on glass, and he accordingly encased in wire gauze some specimens of plate and window-glass [the latter being *crown glass*, we presume], and suspended them from the top of the boiler, so that they were surrounded by steam whenever the boiler was in action. They were kept in this situation for four months, during which time the boiler was commonly in action ten hours daily, except Sundays, its temperature being then at 300° Fahr. On opening the boiler at the end of the time specified, all the pieces of glass were found to have been more or less decomposed; and the plate-glass in particular, which is a glass of silex and soda, was far advanced in decomposition. Flat pieces, one-fifth of an inch thick, were in some parts decomposed through their whole substance; while in others, a layer of unchanged glass was found in the middle, covered on each side with a stratum of opaque white siliceous earth, having the appearance of chalk.

The author referred these changes to the influence of water on the alkaline matter of the glass. The white earthy portions were found to be entirely free from alkaline matter, which had been dissolved and removed by the water which condensed upon the glass at the successive heating and cooling of the boiler, or which may have been thrown upon it by splashing during ebullition. But the author considered that the actual loss was not due to the extraction of alkaline matter only, but that the silex of the glass had in some measure been dissolved along with the alkali. This was proved to have been the case by the apertures of the gauze envelope being filled up at the most depending parts by a siliceous incrustation, where also a stalactitic deposit of silica, about 1¼ inch long, had formed.

A piece of window-glass [crown glass] included at the same time with the plate-glass, was in a decomposing state, but in a much lower degree. A piece of rock-crystal confined in the boiler at the same time was wholly unchanged.

The author adduced these facts as illustrative of the action of water

at high pressures on felspathic and other rocks containing alkaline matters.—*Proceedings of the. Geological Society.*

On the Quantity of Solid Matter suspended in the Water of the Rhine. By Leonard Horner, Esq., F.G.S., F.R.S.—A paper on this subject, of which the following is the official abstract, was read before the Geological Society on the 26th of February last. We transfer it to our pages because the subject of the quantity of solid matter transported by rivers, is one which is daily rising in importance, both in a practical and in a philosophical point of view.

The experiments referred to in this Paper, were made by the author at Bonn, in the months of August and November. The apparatus which he used was a stone bottle capable of containing about a gallon, and furnished with a cork covered with greased leather, having a long string attached to it. A weight was suspended from the bottle by a rope of such a length, that when the weight touched the ground, the mouth of the bottle was at the desired distance from the bottom of the river. The cork was then removed by the string, and the instant the bottle was full it was drawn up.

The first set of experiments was made in August, at 165 feet from the left bank of the river, and at 7 feet from the surface, or 6 feet from the bottom. The Rhine was unusually low, and the water was turbid and of a yellowish colour. The quantity of solid matter obtained from a cubic foot of water, and slowly dried, was 21·10 grains, or about $\frac{1}{20734}$th part. The residium effervesced briskly with diluted muriatic acid, was of a pale yellowish-brown colour, smooth to the touch, and in appearance and properties undistinguishable from the loess of the Rhine valley.

The second set of experiments was made in November on water taken from the middle of the river, and about one foot below the surface. A great deal of rain had fallen some time before, and also fell during the experiment. The water was of a deeper yellow than on the former occasion, but when taken up in a glass was not very different in appearance. The residium of a cubic foot weighed 35 grains, or the $\frac{1}{12500}$th part. The author then enters into an approximate calculation of the medium quantity of earthy matter borne down by the Rhine during 24 hours. He assumes that the annual mean breadth of the opposite Bonn, is 1,200 feet, the mean depth 15 feet, the mean velocity 2½ miles in an hour, and the average amount of solid matter held in suspension to be 28 grains in the cubic foot of water. From these data he deduces the result that 145,981 cubic feet of solid matter are borne past Bonn every 24 hours.

On the Effect of Impact on Beams. By Eaton Hodgkinson.—The author gave the results of some inquiries into the power of beams to resist impulsive forces. The experiments were made by means of a cast-iron båll, 44lbs. weight, suspended by a cord from the top of a room with a radius of 16 feet. The ball, when hanging freely, just touched laterally an uniform bar of cast-iron, sustained at its ends in a horizontal position by supports under it and behind it, four feet asunder. The intention was to strike the bar, sometimes in the middle and sometimes half-way between the middle and one end, with impacts obtained by drawing the ball and letting it fall through given arcs, shifting the bar when the place of impact was to be changed, and obtaining the deflections of the bar at that place by measuring the depth which a long peg, touching the back of the bar, had been driven by the blow into a mass of clay placed there. The results were:

1. The deflections were nearly as the cords of the arcs through which the weight was drawn, that is, as the velocities of impact.

2. The same impact was required to break the beam, whether it was struck in the middle, or half way between the middle and one end.

3. When the impacts in the middle and half-way between that and the end were the same, the deflection at the latter place was to that at the former nearly as three to four, which would be the case if the locus of ultimate curvature, from successive impacts in every part, was a parabola.

The preceding deductions the author had found to agree with theoretical conclusions, depending on the suppositions, (1,) that the form of a beam bent by small impacts was the same as if it had been bent by pressure through equal spaces; and (2,) that the ball and beam where struck, proceeded together after impact as one mass. These suppositions likewise gave as below:

4. The power of a heavy beam to resist impact is to the power of a very light one, as the sum of the inertias of the striking body and of the beam is to the inertia of the striking body.

5. The time required to produce a deflection, and, consequently, the the time of an impact, between the same bodies, is always the same, whether the impact be great or small. The time, moreover, is inversely as the square root of the stiffness of the beam.

6. The results of calculations, comparing pressure with impact, gave deflections agreeing with the observed ones, within an error of about $\frac{1}{7}$th or $\frac{1}{9}$th of the results.—*Report of the Third Meeting of the British Association for the Advancement of Science.*

On the direct tensile Strength of Cast-Iron. By E.

HODGKINSON.—The absolute strength of this metal, notwithstanding the extensive use made of it in the arts, is still a matter of doubt. If we turn for information to authors, we find Mr. Tredgold and Dr. Robison making it nearly three times as great as Mr. Rennie or Captain Brown, and the advocate of the greater strength (Tredgold) attributing the less strength, as found by the others, to the straining force not having been kept in the centre of the prism. For supposing the extensions and compressions to continue always equal from equal forces (which they are under slight strains), a small deviation from a central strain would make a great reduction in the strength; and if the force were applied along the side of a square piece, the strength would be reduced to one fourth. (*Tredgold*, Art. 61, 62, 234.)

The above contrariety of opinion was the cause of the following experiments, in which the utmost care was taken to keep the straining force along the centre of the castings, which had their transverse section of the form +, except in the last two experiments, in which the section of the castings was rectangular, and the force applied exactly *along the side*. The iron was of a strong kind, the same as in the author's experiments on beams (*Manchester Memoirs*, vol. V.), and was broken by a machine on Captain Brown's principle for testing iron cables.

Force up the middle.

Experiments.	Area of section in parts of an inch.	Breaking weight in tons.	Strength per square inch in tons.
1	3·012	22·5	7·47 } tons.
2	2·97	21·0	7·07 } mean 7·65.
3	3·031	25·5	8·41 }
4	2·95	19·5	6·59 Different quality of iron.

Force along the side.

Experiments.	Area of section.	Breaking weight in tons.	Strength per inch.
5	4·83	11·5	2·38 } tons.
6	4·815	13·75	2·855 } mean 2·62

Whence the strength of a rectangular piece of cast-iron drawn along the side is rather more than one third of $7\frac{2}{3}$ tons, its strength, as above found, to bear a central strain (for $\frac{2\cdot 62}{7\cdot 65}$ $\frac{1}{3}$), but from the preceding remarks it ought only to be one fourth; and, therefore, it

would appear that a shifting of the neutral line had made the pieces capable of bearing a greater force along the side than in their natural state.—*Report of the Third Meeting of the British Association for the Advancement of Science.*

A. T.

CRITICAL NOTICES AND REVIEWS.

A Treatise on Internal Intercourse and Communication in Civilized States, and particularly in Great Britain. By Thomas Grahame.—London: Longman, 1834.

Perhaps there is no part of the economy of England in which she so far exceeds all other countries, as in the means of her internal communication; this arises as much from the comparatively small distance of any one part from another, as from the spirit of industry and the talent of her inhabitants: and, with all submission to Mr. Grahame's opinion to the contrary, we would add, that much may also be attributed to the nature of our laws, which admit of the combined capital of a number of persons being brought to bear in realizing large undertakings which individual capital would be unable to accomplish. If, as Mr. Grahame proposes, the power were vested in the government, ministers would seldom be justified in venturing speculatively on a large outlay were the whole blame of failure would rest on themselves; the consequence of which would be, that government would be slow to act; hence the most advantageous period for going into action would often be lost. Our economists in the house of commons would be ever weighing each shilling voted, and a minister would seldom venture on a new undertaking. Let Mr. Grahame but look to France, were a course, similar to that which he advocates, is, and has long been, in practice, yet with a result the very reverse of what he would wish us to believe would be the case.

The internal communication of this country has long

occupied our attention; and we have watched, with an inquiring eye, the numerous propositions of modern times for improving the varioussystems of conveyance on common roads, on canals, and on rail-roads; and from our experience have found advantages in each not possessed by the other: thus, in common roads, the facilities offered by their branching in every direction, and allowing carriages of the greatest variety of construction to travel on them;—in canals (particularly where time is not an object) the great weights which can be carried at a small cost;—and, in railways, the quick transit of goods and passengers.

The construction of good roads was ever considered of the utmost importance in the civilization of mankind; for every means which facilitates the transit of persons and goods, causes industry to be excited, and opens new sources of supply of the requisites, such as manure and soil for the most advantageous cultivation of land, and of the raw materials to the manufactories; there consequently follows a cheapness of production not attainable by other countries where the means of internal communication are less perfect; hence it becomes obvious, that every encouragement should be given by the government of this country for the advancement of the various means of conveyance, having at all times a due regard to the interest already existing, and giving fair remuneration, when legislative enactments are found necessary, to enable new undertakings to be realized.

Mr. Tredgold has very justly remarked*, "To improve the interior communication in this country must be productive of much good, by equalising the distribution of agricultural produce, and allowing that of those districts to which nature has been most bountiful, free access to market. There must necessarily be a very wide difference in the nature of the soils in any country of considerable extent, and it is extremely improbable that the best is

* Practical Treatise on Rail-roads and Carriages, p. 4.

most favourably situated for yielding a fair profit on its produce without the assistance of artificial means of sending that produce to the places of demand. And it is evident that, unless some easy mode of conveyance be resorted to, the demand must be supplied at a greater expense from inferior soils, and of course, from such as require a greater capital to cultivate them without being more productive to the landowner, while they are also less certain of yielding a sufficient quantity to replace the capital expended, and afford the ordinary rate of profit. A cheap and regular mode of conveyance, besides rendering the produce of fertile lands accessible at a less price to any portion of the community also affords new markets for other articles; it creates new sources of exchange and supply, and causes the advantages of labour and industry to spread and expel the idleness and indifference which engraft themselves among those people who, without such means, barely obtain the common necessaries of life; for the ordinary mode of land carriage makes every heavy commodity so expensive that the inhabitants of inland districts are limited to what nature furnishes them with. In many places they are nearly destitute of fuel, and while moderate exertion gives them the scanty supply of comforts within their reach, their utmost efforts scarcely do more; and, therefore, they sink into that languid state of indifference which we find so generally prevalent in such countries. It is true that the construction of railways and canals is expensive; but under proper arrangement, their formation might furnish a considerable degree of employment for the labouring poor, and thus be a relief to the parishes these roads would ultimately benefit."

The engineers of the present day may be said to be divided into two parties, one advocating canals and the other rail-roads; and as is mostly the case in party feeling, neither is ready to admit that there are any advantages derivable by the other means, which are not far

outbalanced by the means the particular party advocates. Mr. Grahame is an advocate of the canal party, and certainly does not look favourably on the progress which railways have made within a few years: he has also some peculiar notions with respect to the manner in which the combined capital of a number of persons is permitted by the laws of this country to be used in effecting an extensive undertaking; he states, that "the proper guardians of public rights, and the proper parties to enforce and improve public privileges, are persons appointed by the public, and responsible to the public:" and he deprecates the system of granting privileges to corporate bodies, such as rail-road and canal companies, as pernicious to the state; in place of which he considers that such undertakings should be carried on by the government: but as Mr. Grahame has only glanced at this part of his views, and has promised in the second volume of this work (which is not yet published) to enter fully into his ideas on this head, we shall leave this part of his work till we have his opinions and arguments fully before us, and at once proceed to consider some of the various facts and data which the present volume contains, first remarking, that we are not at all inclined to agree that government is the most proper party to be invested with the power of executing works like those treated of. The system now pursued is far superior, in which government have a superintending or observing power, and, by their authorized engineer *, examining the practicability and utility of any undertaking, previous to giving their sanction to parties going to parliament for powers; and it will require no moderate degree of reasoning, on the part of Mr. Grahame, to induce us to fall in with his views, that the giving moderate privileges of incorporation to companies is prejudicial to the community at large. Mr.

* Mr. Telford was for some years the government engineer. See p 240. of our last Number.

Grahame, in the present volume, goes almost at once to the subject of the Darlington and the Manchester and Liverpool railways, but as he has given more attention to the latter, we propose pursuing a like course, bringing before our readers some of the principal data from which he draws an unfavourable opinion as to the probability of rail-roads ever answering in comparison with other means of conveyance. In the first place Mr. Grahame points out, and we must say, justly, the great discrepancy between the estimate and ultimate cost of the Liverpool and Manchester railway. That an individual, however talented, may, in a new undertaking, wherein there is but little practically known, fall short of the ultimate cost, we are ready to believe; but unfortunately for the credit of engineers, estimates are universally below, not above, the real outlay. In the instance of the Manchester and Liverpool railway, we find the expenditure more than double the estimate: but Mr. Grahame should remember that this forms no argument in his favour that rail-roads are therefore bad, for if he look into any of the accounts for canals, his more favoured means of conveyance, he will find that like discrepancies have occurred between the estimate and the sum expended in completing the works. The usual defence set up for these discrepancies, is, that were the public really aware of what would be the cost of a new undertaking, and that the truth and nothing but the truth were told, the amount would be thought too great, and there would be exceeding difficulty in disposing of shares; but the holders once having embarked to a certain extent, are either obliged to go on or else to lose what they have already embarked.

The author next proceeds to the published accounts, ending 31st December, 1833, of the Manchester and Liverpool Rail-road Company:

STATEMENT *of* RECEIPT *and* EXPENDITURE *on Capital Account, till* 30*th June,* 1833.

Treasurer, Dr.	£.	s.	d.	*Treasurer, Cr.*	£.	s.	d.
To Amount of Capital on Shares and Loans -	1,047,335	0	0	By Amount of Expenditure on the Construction of Way and Works -	1,059,120	1	5
Receipts for old Materials, and unpaid Dividends	1,479	14	11	In the Hands of Moss and Co., Bankers - - -	13,332	16	5
Net profits of the Concern for the Half-year ending 30th June, 1833 - -	33,171	1	1	In the Hands of the Treasurer - - - -	0	12	0
Surplus on Hand after Payment of 5th Dividend, in February last - -	693	4	1	Arrears of Calls - -	30	11	6
				Balance of Book Debts due to the Company - -	10,194	18	9
	£1,082,679	0	1		£1,082,679	0	1

STATEMENT *of* RECEIPTS *and* EXPENDITURE *on Capital Account, till* 31*st December,* 1833.

Treasurer, Dr.	£.	s.	d.	*Treasurer, Cr.*	£.	s.	d.
To amount of Capital in Shares and Loans - -	1,086,885	0	0	To Amount of Expenditure on Way and Works, including Tunnel Expenditure in progress - -	1,089,818	17	7
Ditto of Dividends not paid -	1,087	3	1	Ditto, in Hands of Moss and Co., Bankers - -	28,476	11	9
Surplus on Hand after Payment of 6th Dividend -	395	10	2	Ditto, in Hands of Treasurer - - - - -	242	15	9
Net Profit of the Concern for the Half-year ending 31st December, 1833 -	40,884	8	4	Ditto, Arrears of Call -	25	3	6
				Ditto, Book Debts due to the Company - -	10,688	13	0
	£1,129,252	1	7		£1,129,252	1	7

From a general examination of the foregoing statements we might be led to suppose, that the entire outlay on the way and works on 30th June, 1833, when the first statement was completed, had been 1,059,120*l.* 1*s.* 5*d.*, and had risen on 31st December, 1833, when the second statement was completed, to 1,089,818*l.* 17*s.* 7*d.*; and that the expenditure on the capital account, in the year 1833, had been, of course, 65,443*l.* 17*s.* 7*d.* This, however, has not been the case: the expenditure has been considerably greater. The apparent diminution is occasioned by inaccuracies in stating the accounts. From the sums placed to credit in each of the foregoing accounts, dividends of 33,864*l.* 5*s.* 2*d.* sterling, and 35,859*l.* 7*s.* 6*d.*, are ordered instantly to be paid to the shareholders, on account of the previous revenues collected. As the company had only 13,332*l.* 16*s.* 5*d.* of disposable funds in bank (the rest being invested in the railway and works), when the first dividend was ordered, they were obliged to borrow 20,000*l.* in order to pay it; which loan then became part of the capital account. For the same reason they were obliged to borrow 11,000*l.* and upwards last January, to pay the dividend then ordered on the profits of the preceding half year. When this last dividend was paid, the capital expenditure would amount to upwards of 1,100,000*l.* sterling, which makes the real expenditure, in the year 1833, on the capital account upwards of 76,000*l.*, or about 6500*l.* per month.

The mistake which I have rectified, arises from the mixture, in he accounts, of the sums received from the revenue, with the sums

laid out in making and finishing the road and works; and has probably given rise to the statement that the railway company are in the regular habit of paying their dividends *by borrowing money*, or creating new stock: and certainly to persons not well acquainted with the state of the company's affairs it is difficult to conceive how dividends of 33,000*l*. and 35,000*l*. and upwards, can be paid by parties who have only on hand 13,000*l*. and 24,000*l*. wherewith to pay these dividends, unless they borrow, or create new stock. The explanation of the directors is as follows: the company, they say, lay out a large portion of their revenue regularly, *as it is received*, in finishing or improving their road and works, and, of course, if they pay dividends, they must borrow money to repay this advance. The money so borrowed is always previously expended in permanent improvements on, or in completing and extending, the works; and the sums so expended have been paid out of the annual revenue. The borrowing, then, is not to pay the dividend, but for the purpose of repayment to the *income account*, of what had been previously taken from it, to be laid out on the *capital account*.

It can never, however, be satisfactorily shown, that an annual expenditure, to complete what is generally considered, and has been represented, as a finished undertaking, ought not to form a portion of the regular annual outlay, and that until these outlays are reduced and extinguished, they should not be defrayed, as far as possible from the revenue.

Though these accounts are certainly not so clear as they might be, yet Mr. Grahame has not treated them fairly. The first dividend of 33,864*l*. 5*s*. 2*d*., in June, 1833, was, according to these accounts, directed to be paid when there was a sum of 13,332*l*. 16*s*. 5*d*. in cash at the bankers; in addition to this, there was outstanding debts, 10,194*l*. 18*s*. 9*d*. The like observation may be made in respect to the second account, where it will be found that there was the sum of 28,476*l*. 11*s*. 9*d*. in hand, and 10,688*l*. 13*s*. book debts. At the same time we do not think the directors were justified in making dividends to the amount of 69,723*l*. 12*s*. 8*d*. in the year 1833, when, according to their own shewing, they had only made 74,055*l*. 9*s*. 5*d*. as net profits in that year, and a large part of that amount still remained on the books as outstanding debts, and must therefore have been more or less uncertain. There ought to be a much

larger amount annually kept back to meet casualties, but more particularly to pay off the loans.

Mr. Grahame next points out the difference of the estimated traffic, and that which has really been the result during the three years working; in this estimate the original calculations have not been verified, nor should we, under ordinary circumstances, have expected they would be.

The following is a table, issued by the directors, in 1829, of the estimated traffic:

FROM LIVERPOOL, OR TOWARDS MANCHESTER.

Daily.		Gross weight about tons.
1000	tons of goods and merchandise, exclusive of waggons, from Liverpool to Manchester -	1500
500	tons cattle, sheep, pigs, &c., that is, the cattle will occupy the room of 500 tons of goods, and the difference in actual weight will not be great - - - *This large quantity may not occur more than two or three days in the week; still it must be provided for, as the conveyance of cattle cannot be delayed*	750
400	tons of coals, a distance of 12 to 15 miles, say from Kenyon to Manchester - - -	600
800	empty coal waggons, a a distance of 8 to 20 miles, say from Liverpool to Whiston, Rainhill, and Newton -	800
800	passengers from Liverpool to Manchester, occupying about 35 carriages - - -	100
	Gross weight towards Manchester, - - Tons	3750

FROM MANCHESTER, OR TOWARDS LIVERPOOL.

Daily.		Gross weight about tons.
500	tons of goods, lime, stone, &c., exclusive of waggons - - -	750
300	empty waggons, or stages, which will have brought cotton or other goods, at 15 cwt. each, say - - -	250
200	empty coal waggons, a distance of 12 to 15 miles, say from Manchester to Keynon -	200
1600	tons of coals, a distance of 8 to 20 miles, say from Newton, or Whiston, to Liverpool -	2400
250	empty cattle carriages -	250
800	passengers from Manchester to Liverpool, occuping about 35 carriages - - -	100
	Gross weight towards Liverpool, - - Tons	3950

By examining the preceding statement, it will be found that the

estimated amount of goods, merchandise, and heavy articles, to be conveyed along the railway annually between Liverpool and Manchester, allowing 312 working days in the year, was no less than 468,000 tons; while the quantity of cattle, sheep, and pigs, amounted to 156,000 tons. The amount of coal contemplated to be carried was less than 624,000 tons. The number of passengers was 1600 daily, or (12 passengers and luggage taken as a ton) about 140 tons each day, equal to above 50,000 tons yearly, supposing the road to be kept open every day in the year. The statement, or estimate, above copied was, when prepared, delivered by the directors to two highly talented engineers, viz. Mr. James Walker, formerly of Limehouse, now of George Street, Westminster, and Mr. Rastrick, of Stourbridge, with a request that, after examining the line of railway, they would advise the directors as to the fittest and cheapest power to be employed on the line, for moving or passing this enormous traffic. Mr. Walker was appointed on account of his general knowledge of railways and public works, and Mr. Rastrick, from his being a practical builder of steam-engines, and familiarly acquainted with their original cost, and the annual cost of repair. Messrs. Walker and Rastrick, after examining the line of Liverpool railway, and surveying the various railways in operation in the neighbourhood of Newcastle and Durham, and particularly the Darlington railway, and obtaining every information as to the expense of working those railways, made out a report, which was delivered to the directors of the Liverpool railway. In this report, Messrs. Walker and Rastrick recommended, that the railway should be worked by reciprocating stationary engines, placed about one mile and a half apart, on the plan of Mr. Thompson, of Ayton-banks, who has taken out a patent for this system of railway conveyance. The joint report of these gentlemen was printed and circulated by the railway directors, and the statements, I believe, are very generally known. In the report, Messrs. Walker and Rastrick estimated the expense or cost of power, necessary to move the traffic in the table made out by the directors, at a gross sum of 43,471*l.*, in case locomotive engines were used; being a cost for motive power of about seven twenty-fifths of a penny per ton per mile. Of the sum so estimated nearly one-sixth, or 6780*l.* 9*s.* sterling, is a charge, supposed to be laid aside each year for replacement of the capital invested in the engines. Messrs. Walker and Rastrick knew well, that, in spite of the best system of repair, the locomotive engines and machinery must, like every article of the kind, be worn out and become useless in a certain number of years, and the sum of 6780*l.* 9*s.* annually, was allotted to meet this annual deterioration on the extent of machinery required to move or pass the trade contemplated by the directors. The sum then required to be annually expended for coal,

wages, repair of engines and wages of attendants employed to convey the amount of traffic, assumed in the estimate, was exactly 36,817*l.* 9*s.* according to the report and calculations of Messrs. Walker and Rastrick. The speed at which the locomotive engines were to move was represented, in this calculation, at *ten miles an hour.*

The expense of the same conveyance by fixed engines was, by these gentlemen, estimated at an amount considerably lower, although the speed was taken at twelve miles per hour; but as the directors, after due consideration, thought proper to adopt the system of locomotive engines, it is needless to consider a scheme hitherto unattempted, in circumstances similar to the Liverpool railway, and the expenses of which are estimated on data chiefly furnished by the patentee.

It is proper to mention, in explanation of the preceeding summary of Messrs. Walker and Rastrick's report, that, as the distances to which the coal was to be conveyed are different, and as the passengers are stated in numbers, not in tons, Messrs. Walker and Rastrick simplify their report, by calculating on a regular trade of 4000 tons of passengers, goods, cattle, and coal, *passed thirty miles* along the railway daily, or their estimate of expense is founded on an annual traffic of 1,248,000 tons, conveyed thirty miles annually, in 312 working days.

Messrs. Walker and Rastrick's report was no sooner published, than an answer to it was prepared and published by Mr. R. Stephenson and Mr. J. Locke, civil engineers, both employed on the Liverpool railway; the first, the son of Mr. G. Stephenson, the principal engineer of that railway. This publication is stated to be compiled from the reports of Mr. G. Stephenson, the engineer of the Liverpool railway, and is made up to show the great errors committed by Messrs. Walker and Rastrick, in their statements, as to the expense of moving or conducting traffic on railways, by the operation of locomotive engines. It is needless to follow Messrs. Stephenson and Locke through their calculations and statements. It is sufficient to present the results at which they arrived, as I have done with those of Messrs. Walker and Rastrick, and then to compare these results of *calculation*, with the actual results of *experience.* Messrs. Stephenson and Locke, after a variety of statements and calculations, represent the expense of working the railway, and conducting the amount of goods, &c. assumed in the estimate of the directors, as 25,517*l.* 8*s.* 2*d.* sterling, annually; or something under one sixth of a penny per ton per mile. Of this amount, 5209*l.* 10*s.* is not properly annual expenditure, but is the yearly tribute to a fund, created, in order to replace the locomotive engines; so that the actual annual cost, according to Messrs. Stephenson and Locke, required to support the passage along

the railway of the traffic in question, was only 20,307*l.* 18*s.* 2*d.*, or something above one-eighth of a penny per ton per mile. The speed of motion they particularise as twelve miles per hour, which is twenty per cent. higher than that contemplated by Messrs. Walker and Rastrick; and at this *increased speed,* they assert, the traffic may be conducted along the railway with a *diminution* of about *sixty per cent.* on the calculation and statements of Messrs. Walker and Rastrick. To simplify the calculations, the distances are equalized, and the number of passengers reduced to tons, viz. to a weight of 4000 tons conveyed daily thirty miles, or 1,248,000 tons conveyed that distance in a year. The calculations from which these results are deduced are made with a degree of minuteness, and apparent accuracy, sufficient to mislead any one not aware that they all proceeded on data or grounds supported only by the untried theories of the parties by whom they were promulgated. The following table exhibits a comparative statement of the results of the reports of Messrs. Walker and Rastrick, and Stephenson and Locke, as to the calculated annual expense of conveying the estimated traffic on the Liverpool railway by locomotive engines :—

TABLE II.

	Capital Outlay.	Annual Expenditure.
Messrs. Walker and Rastrick	£90,963 14 3	£36,817 9 0
Messrs. Stephenson & Locke	58,000 0 0	20,307 18 2
Difference	£32,963 14 3	£16,509 10 10

The discrepancies in these statements are sufficiently great, and the directors of the railway remained undecided, as to what description of power they should adopt, for conveying the contemplated traffic; but as the opinions of Mr. Stephenson, the engineer, and the majority of the directors, inclined in favour of locomotive engines, both as the cheapest power, and that wherein improvement was thought most probable, it was resolved to offer a premium for an improved locomotive engine, which would realise the excellencies contemplated, and turn the scale in favour of locomotive engine power.

When a new means of conveyance is to be realised, the public are fully aware that the estimates are grounded on speculative ideas; they know that much will depend on the greater facilities offered; they are not, therefore, disappointed in the first three years, should the total not be

equal to the estimate, such estimates being very different to those of constructing the works. The first three years, we believe, in ninety-nine out of every hundred, great undertakings, will be found from a want of that regularity and division of labour, which is to be arrived at only by practice and experience, will by no means represent a fair average of what may be expected of future years, even though the gross returns remain nearly the same—take the supply of water or gas to a city—we will venture to say, that few have realized, in the first three years, a comparative return of what they have ultimately made; indeed, how many do we find of the most extensive works in this kingdom, which did not make even a dividend for several years, and yet are now valuable investments for money. The steam-boats between London and Margate, may be taken as a striking instance of the change which greater facilities have produced. What would not a writer like Mr. Grahame have said, in the year 1815, when only the Thames and Majestic were plying between London and Margate, had an estimate been sent out by the engineer, of a proposed company, that it was probable the number of passengers would (during the season) within a few years average five to six hundred per day, and that those to Gravesend would amount to twice that number? The same may be said of the boats to Calais and other parts of the Continent, as well also to Ireland, Scotland, and the coasting trade: but it is not the mere transplacing of persons or merchandize, which is to be considered when looking at the subject in a national point of view. We must then weigh well the changes in feelings and tastes of the populace in general; but on this point Mr. Grahame is silent: he sees no advantages of quickness and certainty of travelling, and he makes the following most extraordinary assertion:

Time is undoubtedly money, but only to the working or producing classes. It is however, like paper money, not always convertible into gold, and unless convertible instantly, it instantly loses its value,

What is the value of time to the men and horses thrown out of employment and demand, by the introduction of locomotive engines, to work on a railway? The time assuredly, which is most valuable to the community, is, what the possessors are willing and ready to dispose of at the lowest price; whilst the time that is at the disposal of some individuals, though really possessing no intrinsic value, cannot be purchased at any price whatever.

There is in the present day a common cant which pays court to the multitude. The political economists talk of the productive classes, and refer all wealth and power to that head; but, strange to say for their consistency, they all speak with admiration of the increasing knowledge of the working classes, yet the moment any one of them, by the aid of such knowledge, combines wealth with talent, and rises to that condition that he works no longer with his own hands, but directs the hands perhaps of hundreds, and thus enables them to work with more advantage to themselves and the community, he is taken out of the class of producers, and his time is no longer a material worth consideration: such also is the doctrine of Mr. Grahame. We do profess to know something of the nature and worth of the working classes, and also the worth of, and necessity for, the heads of the many establishments, by which the large masses of the operatives are guided; but it does not require a very intimate acquaintance with either, to feel the absurdity of such an expression as that "*time is undoubtedly money, but only to the working or producing classes.*" We have the highest opinion of the working population in general; and we are proud that we live in a country were, by industry and talent, an individual may, from the lowest ranks, raise himself to the highest: and of this how many excellent examples we have in every county in this country. Nothing can be more absurd in reasoning, or more cruel to the poor, and, for the most part, uneducated classes, than to tell them that their time is of the most consequence to the world at large, and that those who do not spin or weave, or sow or reap—their time is of no value,

however much those individuals may, by their talent and research, point out and direct the energies of the labouring classes, which, but for the well-directed aid of a higher class, would be weak indeed. It is no uncommon thing, in the present day, to read and hear that the masters, the merchant, and all persons not engaged in producing by their hands, are so many taxes, to be supported by the toil of the working classes: to such an extent has this description of argument been pursued, that in modern strikes the unionists have declared their determination not to go to work unless piece-work be done away and all men paid alike: ability and industry are no longer to claim a preference or receive more reward.

Pursuing Mr. Grahame's and such economists' course of reasoning, we shall not be surprized, in our next war, which we trust is far distant, to find writers objecting to generals and subordinate officers as unnecessary, seeing that the privates do all the killing. But we must leave this part of the subject and proceed.

Mr. Grahame is an advocate for horse in preference to steam power, though he acknowledges that the former, being fed by corn, which is taxed, cannot compete with the latter, which is fed by untaxed coal; hence he conceives it to be necessary to repeal the corn laws; that is to say, he considers it better to depend on the importation of foreign corn to feed an increased number of horses, than to obtain an equal power by a native mineral, the getting of which employs many thousands of the working classes: he boldly says: "Remove the taxes on corn and reduce the keep of horses one half, and the question of railways and turnpike roads is settled beyond all doubt." We suspect he would have said, "*The question of railways and canals is settled,*" &c.: but he forgets that the cost of working railways would also be reduced; the getting of iron and of coal, all description of labour, would be reduced; and the cost of land,

also, by which the competition would still go on, and the various means of conveyance would remain in about the same relative position they are now in.

Mr. Grahame states that—

The effect of the British corn laws has been, first, the stoppage of the extension and improvement of British inland intercourse and communication, when advancing in a course in the highest degree advantageous to the landed interest, by occasioning a great and increasing demand for agricultural produce; and, secondly, to force the tide of extension and improvement of British inland communication into a course (the substitution of mechanical for animal motive power) which bids fair to inflict a much more serious injury on the interests of the British landholder, than that which he expects to guard against by the corn laws,—by greatly diminishing the present consumption, and closing a great source of future demand for agricultural produce.

It is sufficient here to say that, besides doubling the ordinary charges of communication and conveyance, and, of course, diminishing enormously, the amount of all British intercourse carried on by animal power, these laws act directly as a premium, given by the landed interest, for the encouragement of the introduction and employment of mechanical, in place of animal power; for the substitution of a power fed by untaxed coal, in place of a power fed on taxed corn. The effect of the corn laws, has been already, to supersede the employment of men and horses, in many situations, where, but for those laws, they would still be in active and increasing employment and demand; and to cause our artizans and labourers to emigrate, and export themselves, in search of that cheap food which they are not permitted to import and consume at home.

One signal effect of the corn laws at present is, a bounty or premium on the substitution and use, of mechanical, in place of animal power; and the introduction and use of this power, where it would otherwise never have been thought of. Rescind the corn laws, and there will not, except in very particular circumstances, be a locomotive engine, in existence, in Great Britain, in the course of a year: continue these laws, and the unequal system of taxation on turnpike road coaches, and there is every prospect that, in a few years, mechanical power may become the universal motive power, whether on railways or turnpike roads.

There appears in these last extracts (taken from different parts of the work) a seeming inconsistency. How the landed and agricultural proprietors will have their estates advantaged by using animal power in preference to mechanical power, when corn to support animal power

is to be purchased from a foreign country, is, to us, most inexplicable. If the advocates for repealing the corn laws cannot find a stronger argument than that it will be the means of doing away the mechanical power which is employed for the various means of conveyance, always bearing in mind that the coal, by which such mechanical power is supported, is a cheap product of this country, and employs many thousand hands in getting and transporting it. We say, if the advocates of the repeal of the corn laws cannot find better and stronger arguments than these, we suspect that those laws will long remain amongst the statutes of this realm. Corn is an essential to life, but, from a variety of circumstances, cannot be grown in this country at a price so low as in some other countries; yet its being a necessary of life, must be protected, if the country be well governed; for in the event of war, with the laws repealed, difficulties would and must arise in obtaining a sufficient supply of corn, from the circumstance that the larger part of the land of this country, during peace, would go out of cultivation, owing to the low prices at which corn might during some years be imported, such land could not, within a moderate period, be brought again into cultivation; and in the event of short crops abroad, what would become of this country? The corn laws have been very generally clamoured against as preventing or curtailing the greater and cheaper produce of manufactures, with a view to a more extensive supplying of the foreign market; yet few stay to consider the consequence which would follow at home. For such half-way thinkers, we will quote the evidence given by Mr. Houldsworth*, who is a very extensive manufacturer at Glasgow, and at the same time a highly talented man:

"Question. Do you think the repeal of the corn laws would be beneficial to the manufacturing interests of the country generally?

"Answer. I do not know that it would; it might

* Before the committee on manufactures, commerce, and shipping, in 1833. See Report, p. 317.

probably so far as regards our foreign trade; but though it might increase our foreign trade, still I should rather fear that it would reduce, to a serious degree, the means of purchasing amongst the agricultural classes; and if it did so, it would probaby effect the manufacturers to a degree equal to any advantage they could get from the foreign trade.

"Question. Would not such reduction of the means of purchase of the agricultural classes be more than compensated by a general increase of the means of consumption which would be left in the hands of the community at large who would buy the agricultural produce cheaper?

"Answer. I should think the interest of the agricultural part of the country is so immense, and such a great proportion of the community consists of that class that anything that would depreciate that class would very seriously depreciate all other classes in a way that I do not think could be compensated by any advantage whatever to arise from that circumstance, although I admit that we would be able to manufacture cheaper and to meet the competition more readily than we can do now."

We shall, for the present, leave Mr. Grahame and the subject of internal communication, though we shall be glad to return to them again when Mr. Grahame completes his work. We hope that he will favour us with equally extensive information on the subject of canals and turnpike roads. For the present volume we can only remark, that there is too much of an *ex-parte* appearance throughout its pages; at the same time we shall be content if he treat the subjects of canals and turnpike roads with equal severity with rail-roads; this will be but fair, and truth will equally prevail: but we suspect there will be one of these subjects which will meet with more favour from our author.

NOTICE OF EXPIRED PATENTS,

(Continued from p. 257.)

John Butter Lodge, and John Billeston, junior, both of the Strand, Middlesex, Truss Makers, for certain improvements in the construction and application of spring trusses or bandages for the cure of hernia.—Sealed June 20, 1820.

John Vallance, of Brighton, Sussex, Brewer, for a method and apparatus for freeing rooms and buildings (whether public or private) from the distressing heat sometimes experienced in them, and of keeping them constantly cool, or of a pleasant temperature, whether they are crowded to excess or empty, and also whether the weather be hot or cold.—Sealed June 20, 1820.

John Vallance, of Brighton, Sussex, Brewer, for a method and apparatus for packing and preserving hops.—Sealed June 20, 1820.

John Shaw, of Mary-street, Fitzroy-square, Middlesex, Watchmaker, for a new method of making bricks by machinery.—Sealed June 21, 1820.

LIST OF NEW PATENTS.

English Patents.

Cornelius Tongue, of Gatacre Park, in the County of Salop, Esq., for certain improvements in apparatus for preventing accidents to travelling carriages of various descriptions.—Sealed September 25, 1834.—(*Six months.*)

Jean Baptiste Mollerat, now residing with Sir John Byerley, at Whitehead's Grove, in the Parish of Saint Luke, Chelsea, in the County of Middlesex, Manufacturing Chemist, for certain improvements in the manufacture of gas for illumination.—Sealed September 25, 1834.—(*Six months.*)

Richard Witty, of Hanley, in the County of Stafford, Civil Engineer, for an improvement or improvements in saving fuel and burning smoke applicable to furnaces and stoves.—Sealed September 25, 1834.—(*Six months.*)

Joseph Saxton, of Sussex Street, in the County of

Middlesex, Mechanician, for improvements in printing presses and in presses for certain other purposes.—Sealed September 25, 1834.—(*Six months.*)

SAMUEL DRAPER, of Radford, in the County of Nottingham, Lace Maker, for an improved manufacture of figured bobbin nett, or what is commonly called bobbin nett lace.—Sealed September 25, 1834.—(*Six months.*)

JAMES GARDNER, of Banbury, in the county of Oxford, Ironmonger, for certain improvements on machines for cutting Swedish and other turnips, mangle wurzel, and other roots used as food for sheep, horned cattle, and other animals.—Sealed September 25, 1834.—(*Six months.*)

JOSEPH CLISSILD DANIELL, of Twerton Mills, near Bath, in the County of Somerset, Clothier, for an improvement or improvements in the process of manufacturing or preparing woollen cloth.—Sealed September 25, 1834.—(*Six months.*)

RICHARD FREEN MARTIN, of Hercules Buildings, Lambeth, in the County of Surrey, Gentleman, for a certain process or processes, method or methods, of combining various materials so as to form stuccoes, plaisters, or cements, and for the manufacture of artificial stones, marbles, and other like substances used in buildings, decorations, or similar purposes.—Sealed October 8, 1834.—(*Six months.*)

JAMES JAMIESON CORDES, of Idol Lane, in the City of London, Merchant, for a certain improvement or improvements in machinery for making nails. Communicated by a foreigner residing abroad.—Sealed October 8, 1834.—(*Six months.*)

JAMES JAMIESON CORDES, of Idol Lane, in the City of London, Merchant, for a certain improvement or improvements in machinery for making rivets and screw blanks or bolts. Communicated by a foreigner.—Sealed October 8, 1834.—(*Six months.*)

BENJAMIN HICK, of Bolton le Moors, in the County

Palatine of Lancaster, Engineer, for certain improvements in locomotive steam-carriages, parts of which improvements are applicable to ordinary carriages and to steam-engines employed for other uses.—Sealed October 8, 1834.—(*Six months.*)

THOMAS SHARP, of Manchester, in the County Palatine of Lancaster, and RICHARD ROBERTS, of the same place, Engineers, for certain improvements in machinery for spinning and doubling cotton, silk, flax, and other fibrous materials. Communicated by a foreigner residing abroad. — Sealed October 8, 1834. — (*Six months.*)

JOHN ERICSSON, of Union Wharf, Albany Street, Regent's Park, in the County of Middlesex, Engineer, for certain improved machinery applicable for propelling vessels.—Sealed October 10, 1834.—(*Six months.*)

RICHARDS ELKINGTON, of Birmingham, in the County of Warwick, Optician, for an improvement or improvements in the constructing, making, or manufacturing of spectacles.—Sealed October 10, 1834.—(*Six months.*)

THOMAS SEARLE, of Coleman Street, in the City of London, Merchant, for certain improvements in boilers for generating steam. Communicated by a foreigner residing abroad. — Sealed October 11, 1834. — (*Six months.*)

LORD BARON AUDLEY, of Releigh Castle, in the County of Stafford, for an apparatus or machine as a substitute for, or to be attached to, locks or other fastenings, which he denominates a lock protector.—Sealed October 11, 1834.—(*Six months.*)

SAMUEL SEAWARD, of the Parish of All Saints, Poplar, in the County of Middlesex, Engineer, for certain improvements in the construction of steam-engines.—Sealed October 17, 1834.—(*Two months.*)

CLAUDE MARIE HILAIRE MOLINARD, of Brewer Street, Golden Square, in the County of Middlesex, Merchant, for a certain improvement in looms or machinery for

weaving fabrics. Communicated by a foreigner residing abroad.—Sealed October 17, 1834.—(*Six months.*)

George Littlewort, of Rahere Street, Goswell Road, in the County of Middlesex, Watch and Clock Maker, for certain improvements on watches and clocks.—Sealed October 17, 1834.—(*Six months.*)

Malcolm McGregor, of Manchester, in the County of Lancaster, Manufacturer, for certain improvements in machinery for slubbing, roving, spinning, twisting, and doubling cotton and other fibrous materials.—Sealed October 20, 1834.—(*Six months.*)

James Jones, of Salford, in the Parish of Manchester, in the County of Lancaster, Machine Maker, for certain improvements for making rovings, spinning and doubling of cotton, silk, flax, and other fibrous substances.—Sealed October 20, 1834.—(*Six months.*)

Manoah Bower, of Birmingham, in the County of Warwick, Manufacturer, and George Blyth, of the same place, Merchant, for certain improvements on, or addition to, saddles for horses.—Sealed October 22, 1834.—(*Six months.*)

Jean Baptiste Pleney, of Panton Square, in the County of Middlesex, Brickmaker, for certain improved machinery for manufacturing articles out of brick and other the like earth. Communicated by a foreigner residing abroad.—Sealed October 22, 1834.—(*Six months.*)

James and John Hartley, of West Bromwich, near Birmingham, Glass Manufacturers, for a certain improvement or certain improvements in the manufacture of glass.—Sealed October 22, 1834.—(*Six months.*)

John Stanley and John Walmsley, both of Manchester, Mechanics, for certain improvements on grates or apparatus applicable to steam-engines or other purposes, and in apparatus for feeding the same with fuel, which apparatus conjointly or separately may be applied to other purposes.—Sealed October 22, 1834.—(*Six months.*)

AMASA STONE, of Johnstone, in the county of Providence, and state of Rhode Island, in the United States of America, Machinist, now residing at Liverpool, in the County of Lancaster, for an improvement on power and other looms and in the weaving of silk, hempen, cotton, woollen, and other cloth.—Sealed October 23, 1834.—(*Six months.*)

GEORGE DANIEL CAREY, of Bosford, in the county of Nottingham, Hat Manufacturer, for certain machinery or apparatus to be employed in the manufacture of hats.—Sealed October 23, 1834.—(*Six months.*)

Scotch Patents.

JOHN GEORGE BODMER, of Bolton-le-Moors, in the County Palatine of Lancaster, Civil Engineer, for certain improvements in the construction of grates, stoves, and furnaces, applicable to steam-engines and many useful purposes.—Sealed September 12, 1834.

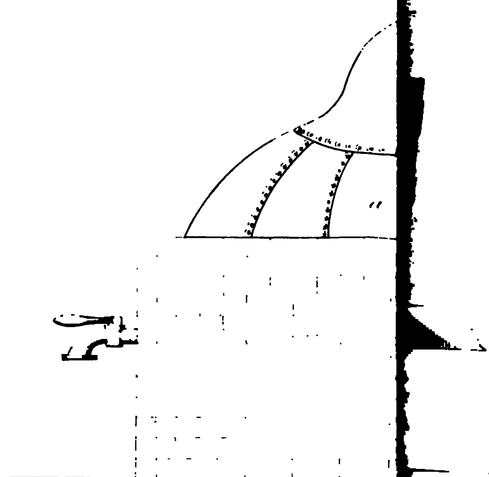
JOHN GEORGE BODMER, of Bolton-le-Moors, in the County Palatine of Lancaster, Civil Engineer, for certain improvements in steam-engines and boilers applicable both to fixed and locomotive engines.—Sealed September 12, 1834.

JAMES BERRIE and DAVID ANDERSON, both of the City of Glasgow, in Scotland, Manufacturers, for a machine or machines for making a new or improved description of heddles or healds to be used in weaving.—Sealed September 19, 1834.

ERRATA IN No. X.

Page 198, line 8 from bottom,		
— 199, — 8 from top,		
— — — 9 ——,	*for* centicular *read* lenticular.	
— — — 28 ——,		
— 202, — 19 ——,		
— 237, — 17 ——,	*for* Turreel *read* Turrell	

Plate XIV. Vol. II. New series.



THE

REPERTORY

OF

PATENT INVENTIONS.

No. XII. NEW SERIES.—DECEMBER, 1834.

Specification of the Patent granted to Joseph Shee, *of Laurence Pountney Place, in the City of London, Gentleman, for certain Improvements in Distillation.* —Sealed April 22, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said Joseph Shee, do hereby declare the nature of my invention and the manner in which the same is to be performed are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed and to the figures and letters marked thereon (that is to say):

My invention consists in a peculiar arrangement of apparatus for distillation, as will be hereafter fully described.

Description of the Drawing.

In fig. 1, *a*, is an ordinary still. *b*, is a second still, connected to the still, *a*, in such manner that the vapours rising therefrom shall pass through the lower part of the

still, *b*, and give off heat to the fluid contained therein; and this I prefer to accomplish by means of tubes passing through the still, *b*. These tubes open into the box, *l*, into which the vapours of the still, *a*, flow, and thence pass through the tubes contained in the still, *b*; and thereby evaporate the fluid contained in this still. *c*, is a third still; and *m*, is a trunk or box communicating from the tubes contained in the still, *b*, to a like series of tubes contained in the still, *c*, so that the vapours from the still, *a*, having passed through the tubes in the still, *b*, next pass through the tubes in the still, *c*, and likewise heat the fluid contained in this third still, and cause it to be evaporated: but this effect is further advanced by the vapours which are raised in the still, *b*, being also passed through the still, *c*, by means of a series of tubes contained in the still, *c*; and this is accomplished by the beak, *n*, of this still passing into a box at the back of the still, *c*, into which the tubes open: but it should be here remarked, that the products or vapours of the still, *a*, and the still, *b*, do not mix with each other, nor do the contents or vapours of any one still mix with that which is in another still. *d*, is a fourth still, having a like series of tubes to those described to the stills, *b* and *c*, there being a box, *o*, opening from the tubes through which the vapours from the still, *a*, are conveyed through the still, *b*, so that those vapours are conveyed through the still, *d*, as well as through the stills, *b* and *c*; and thence by the pipe, *p*, into a series of pipes contained in the vat or vessel, *x*, (which contains wash which becomes heated before passing into the still, *a*,) and thence into the worm-tub, *q*, and is there condensed and passed off to the receiver, *r*. The vapours which are raised in the still, *b*, have already been stated to pass by a series of tubes through the still, *c*; from thence, by means of the trunk or box, *e*, they pass through a series of tubes contained in the still, *d*, and thence by means of the pipe, *f*, they pass through the worm-tub and become condensed and

flow into the receiver, *s*. The vapours which are raised in the still, *c*, are conveyed into the box, *g*, and thence through a series of tubes contained in still, *d*, from whence they pass, by the pipe, *h*, through the worm-tub, and flow into the receiver, *t*; and the vapours from the still, *d*, pass immediately through the worm-tub and into the receiver, *u*. Each of the stills, *a*, *b*, *c*, and *d*, have a pipe, *v*, descending from the bottom. On each of these pipes, *v*, there is a stop-cock, and the object of these pipes is to draw off the residue, if any, after every operation, which residue flows into the pipe, *w*, by which it may be conveyed back into the still, *a*, there to be again distilled with the next charge of wash, or it may be conveyed into any receiver till there is sufficient to form a charge of itself. According to the arrangement shewn in the drawing, it is conveyed into the still, *a*, that is, into the first still of the series. A, is a pipe ascending from the receiver, *r*, into a tank or vessel, B, which is situated above the still, *b*; and C, is a pipe (having a stop-cock) decending from the vessel, B, into the still, *b*, to supply that still with the product which has been distilled over from the still, *a*, and pumped up from the receiver, *r*, as will be hereafter fully described. D, is a pipe rising from the receiver, *s*, into the vessel or tank, E, placed above the still, *c*, there being a descending-pipe, F, therefrom (having a stop-cock), by which the still, *c*, is supplied with the product of the still, *b*, pumped up from the receiver, *s*. G, is a pipe ascending from the receiver, *t*, into the tank or vessel, H, which is placed above the still, *d*, there being a descending-pipe, I, (having a stop-cock), by which the product of the still, *c*, is supplied to the still, *d*, after being raised from the receiver, *t*, as will be fully described when I come to describe the manner of carrying the process of distillation when using this apparatus. But before I describe this process, I would first observe, that I have not thought it necessary to describe or shew in the drawing the various pumps and apparatus

for working the same, which will be required for raising the products of the stills from the receivers, *r*, *s*, *t*, into the tanks or vessels, B, E, H, they forming no part of my invention, and will be readily applied by any person competent to perform the other part of the work; nor do I confine myself to that means of raising the products from the receivers, though I conceive that arrangement to be the best under most circumstances. And I would further observe, that it is not essentially necessary that the parts of the apparatus above described should be arranged precisely as shewn in the drawing, but may be varied to suit the locality and other circumstances of the premises in which it is to be placed, the arrangement being immaterial, provided the process hereafter described is capable of being performed. It will be evident, that although I have described series-tubes for the passage of the distilled products to pass through the various stills, I do not confine myself to the use of tubes only, but in some instances intend to use flat and undulated surfaces, the vapours being on one side and the contents of the still on the other; but I prefer the tubes as offering the most extensive surface. And in order to the clear understanding of the arrangements of tubes, I have, in fig. 2, shewn the stills in section, an inspection of which will render the same most evident. In the drawing I have shewn the worms attached to the various pipes leading from the four stills as being contained in one worm-tub or vessel, but it is evident that the same may have separate worm-tubs to each still, to suit the convenience of the situation in which the apparatus is placed.

Having described the arrangement of apparatus constructed according to my invention, I will now describe the process of operation which it is intended to accomplish, in doing which I will suppose the still, *a*, is capable of receiving 800 gallons of wash, and that the same will distil over 300 gallons of products; by the time the wash in the still, *a*, becomes spent this 300 gallons pass off in the form of

vapour at the beak-head, through the series of tubes for that purpose contained in the stills *b, c, d,* thence through the preparing-vat, and thence to the worm-tub, and then into the receiver, *r*. This product is to be raised into the the vessel, B, either continually during the process, or otherwise, provided it be ready for changing the still, *b*, when the still, *a*, has been worked off. The spent wash is next to be run off from the still, *a*, and a fresh charge of wash supplied from the preparing-vat, and the cock on the pipe, C, is to be opened, and thereby supply the product of the former distillation from the still, *a*, into the still, *b;* the cock is again to be closed, and the process will proceed. The vapours will again be distilled over from the still, *a*, and pass through the various stills, as above described, and be received condensed in the receiver, *r;* but in this instance the former product will be again distilled over from the still, *b*, by the heat of the vapours from the still, *a*, and the product of this distillation will pass through the respective series of tubes contained in the stills, *c*, and *d*, and through the worm tub, and into the receiver, *s*, and from thence is conveyed, as above described, into the vessel, E. The second charge of the still, *a*, being now distilled over, and received in the receiver, *r*, the spent wash is to be run off and the residuum from the still, *b*, permitted to run into the still, *a*, as above described, by means of the cock on the pipe forming part of the third charge to the still, *a*. The cock is then closed, and the product of the second charge to the still, *a*, is then to be run into the still, *b*, and in the meanwhile the products of the first charge of the still, *a*, which has now been re-distilled by the still, *b*, is to be permitted to flow into the still, *c*, by means of the cock on the pipe, F, which is afterwards to be closed, and the process goes forward: the third charge in the still, *a*, is distilled over as above described, as is also the charge in the still, *b*, the vapours from *a*, and *b*, heating in their progress the still, *c*, and distilling over its contents; the products of each

of these stills being received into their respective receivers, and conveyed into their respective tanks or vessels above, in order to supply the stills in the order above described. The spent wash is to be run off from the still, *a;* the residuum contained in the stills, *b*, and *c*, run into the still, *a*, to form part of the fourth charge. The stills, *b*, *c* ,and *d*, are to be charged from their respective tanks or vessels; by this means the product which was obtained from the first charge of the still, *a*, will have arrived at the still, *d;* the process then goes on, and by the distilling over the fourth charge from the still, *a*, the stills, *b*, *c*, and *d*, will also distil over the charges respectively contained. By this last operation the product obtained from the first charge of wash will have passed through the whole process and be received into the receiver, *u*. Thus is the process to be continually carried on, the products proceeding one stage in the process at the working off of each charge of the still, *a*, and by the same heat which is requisite under ordinary circumstances for the mere purpose of distilling over the contents of that still.

Having now described the manner of combining and using the apparatus according to my invention, I would have it understood that I lay no claim to the various parts separately of which the apparatus is formed ; and although I have only mentioned distillation from wash in order to produce spirits highly concentrated, yet it will be evident that other distillation may be carried on with similar apparatus. And I would further observe, that I am aware that stills have been heretofore heated by means of steam, and also the vapours generated in one still has been caused to heat a second still; I do not, therefore, claim this as any part of my invention, nor do I confine myself to the use of only four stills, but intend sometimes to increase or decrease that number, according to the object to be accomplished: but I do hereby declare, that what I claim, is, the method or process, as above described, whereby I am enabled to carry on the

process of re-distillation through a series of stills working simultaneously, and by the same heat as is used to work off the first still, and whereby the product is advanced one stage of the necessary process at each charging of the said first still, as above described, and whereby the products are kept distinct.—In witness whereof, &c.

Enrolled October 22, 1834.

Specification of the Patent granted to MARCEL ROMAN, *of Saint Michael's Alley, Cornhill, in the City of London, Merchant, for certain Improvements on, or Additions to, Machinery for Throwing or Winding Silk or other Threads.*—Sealed November 19, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Marcel Roman, do hereby declare that the nature of the said invention and the manner of carrying the same into effect are set forth and described as follows (that is to say):

The said improvements on, or additions to, machinery for throwing or winding silk or other threads, are applicable to winding-machines for winding silk or other threads off from bobbins on to reels, to form skeins or hanks on those reels; or to throwsting-machines for throwing or twisting and at the same time winding silk from bobbins on to reels to form skeins thereon. And the said improvements on, or additions to, the said machines consist in applying thereto certain parts, which I will hereinafter describe, with reference to the drawing annexed, *videlicet:* A train of regulating wheel-work, connected with the reel, and turned round thereby; which train of regulating wheel-work operates at stated and regular intervals (*videlicet,* whenever the reel has made a certain number of turns) by means of catches,

levers, and other intermediate parts, which I will hereinafter more particularly describe, upon an eccentric pin-wheel or crank-wheel, which gives the usual traversing motion to the layer or guide-rail. And in so operating, the train of regulating wheel-work causes the centre of the eccentric pin-wheel to move a little, and thereby to move the layer and its row of guides a little distance endwise in the direction of the length of the reel, so that whenever this operation of the regulating wheel-work and other parts takes place, the guides are shifted away from the places where they stood and come opposite different parts on the length of the reel, whereby threads or skeins will cease to be laid on those parts of the reel opposite to which the row of guides stood before, and a fresh set of skeins will begin to be laid by the side of the first set of skeins, but a little apart from it.

The number of coils of thread in, and consequently the total length of, each skein must necessarily correspond to the number of turns made by the reel, between the intervals at which the wheel-work is adapted to operate upon the eccentric pin-wheel and row of guides, because the said wheel-work derives its motion, as aforesaid, from the reel itself. When the number of skeins of equal length, that it is intended should be wound off from each bobbin, has been so wound on to the reel, the train of regulating wheel-work operates by means of levers acting upon clutch-bars, to disengage the axis of the reel from the pinion that gives it motion when the machine is at work, and thus stops the machine.

The object of the said improvements on, or additions to, winding or throwsting-machines, is, therefore, to cause them to regulate accurately the number of turns or laps of silk or other thread that shall be coiled round the reel to form each skein or hank, so that when the skeins are taken off the reel they shall all contain a given and equal length of thread; and, further, to cause the layer (or rail on which are the guides through which the threads pass

Roman's Patent

Fig. 1.

Horizontal Plan

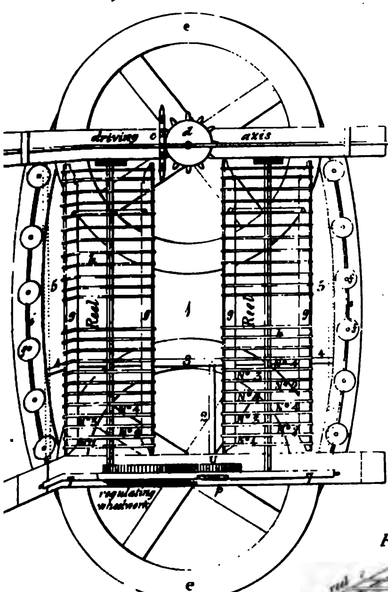
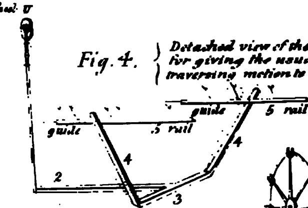


Fig. 4. Detached view of the tackle for giving the usual traversing motion to the layers



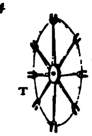


Fig. 6.

Fig. 5.

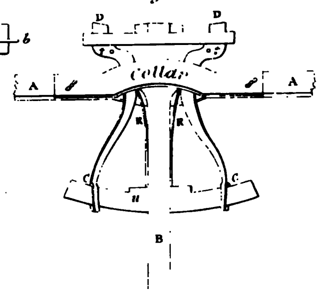


Fig. 7.

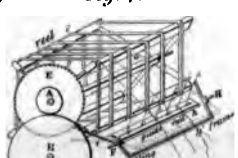
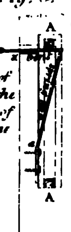


Fig. 3.



Section of one of the uprights of the frame

End Elevation.

Fig. 2.

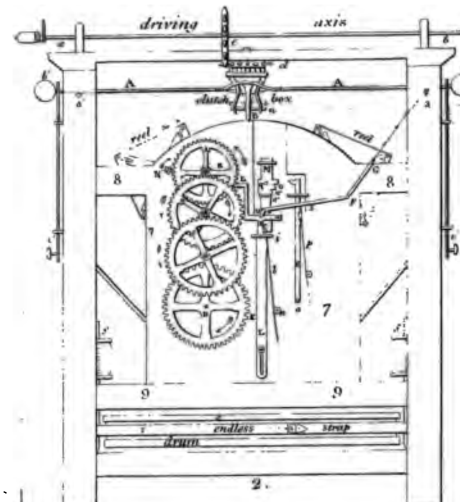
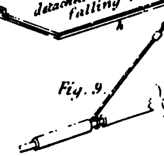


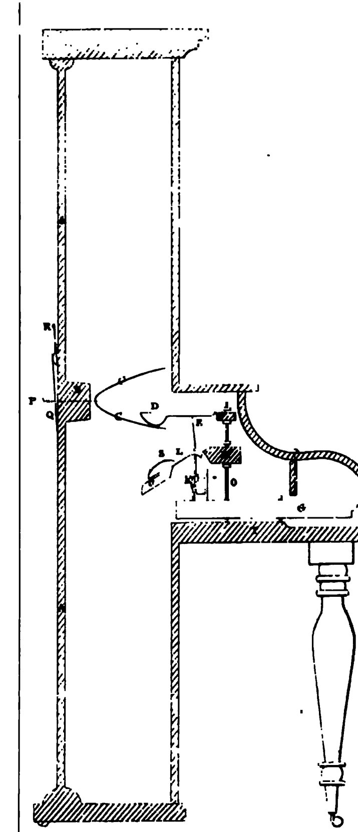
Fig. 8.

Fig. 9.



detached view of the guide spindle & a guide

Gurney's Patent



from the bobbins to the reels) to move a little endwise at stated and regular intervals, while the machine is going on, so as to lay more than one skein or hank on the reel from the same bobbin, leaving spaces between the skeins so wound off from the same bobbin, and every successive skein, containing the same number of laps round the reel, and, consequently, the same length of thread as the preceding skein; and, lastly, to cause such machines to stop, by a self-acting movement, as soon as the last row of skeins has been wound upon the reel.

Description of the Drawing.

For the more complete explanation of the said invention, I have hereunto annexed a sheet of drawings, whereon fig. 1 and 2, represent a plan and elevation of a winding or throwsting-machine, with the said improvements applied to it. *a*, *b*, is the driving axis which is turned round by a handle to give motion to the whole machine, by means of a pinion, *c*, of ten teeth, working into another pinion, *d*, on a vertical axis, on which is a drum, *e*, *e*, placed at one end of the machine, and at the lower part thereof, at the opposite end of the machine, *videlicet*, at the end exhibited in fig. 2, is another similar drum, *e*. An endless band, *i*, *i*, encompasses these two drums, and gives motion to the spindles of the bobbins, *f*, *f*, as is usual in throwsting-machines, the spindles of the bobbins being supported in an oval frame, see the plan, fig. 1.

The machine represented in figs. 1 and 2, is double, that is, there are two reels, *g*, *g*, with a set of bobbins, *f*, and a layer and row of guides belonging to each, and both reels may be driven from the axis, *a*, *b*, by means of wheel-work not shewn in the drawing, the several wheels being of suitable sizes to give the requisite speed to take up the silk or thread from the bobbins.

The usual traversing-motion is given to the layer by an eccentric pin-wheel, set in motion by the reel, see figs.

1 and 4, *videlicet*, on one end of the axis of one of the reels withinside of the frame of the machine is fitted a wheel of twenty-two teeth, which works into an intermediate wheel, also of twenty-two teeth, and that turns a wheel, U, of thirty-five teeth, on the face of which is an eccentric pin, which is linked by a long vertical rod to a horizontal rail, 2, figs. 1 and 4. The end of the rail, 2, is joined to a crop-rail, 3, from which two oblique rails, 4, 4, rise up, the upper ends of which are jointed to the horizontal layers or guide-rails, 5, 5. Hence when the eccentric pin-wheel, U, is turned round it gives a very small up and down motion to the end of the end of the horizontal rail, 2, to which it is connected, and thereby transmits a traversing or backward and forward jogging motion to the layers or guide-rails, 5, 5, in order to cross the coils of silk or thread, and lay them regularly upon the reels.

All the parts hereinbefore described form no part of the improvements, and are like the parts of machines in use in their operation.

In fig. 2, the train of regulating wheel-work, and the parts connected therewith, that constitute the improvements, are principally exhibited. N, is a pinion of five teeth, fitted on the end of the axis of one of the reels, which projects through a frame or plank, 7, 7, made fast to the cross rails, 8, 9, at the end of the machine. The pinion, N, turns on a wheel, A, of fifty teeth, on the axis of which is a pinion of six teeth; then a wheel, B, of fifty-four teeth, with a pinion of six teeth; then a wheel, C, of sixty-four teeth, with a pinion of six teeth; lastly, a wheel, D, of seventy-five teeth: by this train, the speed is reduced, so that the last wheel, D, makes one turn for every 12,000 turns of the pinion, N, and reel, *g*, *g*. I, H, L, is a lifting-lever, mounted on a fixed centre-pin at I, which passes through a long slot in the end of the lever, so that the lever can be slided up and down again on its centre of motion, and it is guided at the upper end by a

collar at *i*. *l*, is a spring fastened to the lever, I, H, L, the end of which bears against a stud, *n*, and presses the lever, I, H, L, towards the wheels, A, and D, to keep it up to its work, as is shewn in fig. 2. To the wheel, A, a wiper, R, is fixed, which is intended to operate upon the projecting-catch or tooth, L, at the upper end of the lever, I, H, L; and on the rim of the wheel, D, are four chocks or small wipers, one of which is intended to operate upon the projecting-tooth or catch, K, at the lower end of the lever, I, H, L, at every quarter of a revolution of the wheel, D: but the said chocks or wipers are not shewn in the drawing, as they are between the wheel and the plank, 7, 7. M, is a sliding-plate, which is guided in collars or guide-plates screwed to the frame, 7, 7: it has three notches in it, Q, Q, Q, at the upper end, and a fourth notch towards the lower end; also it carries the centre-pin, *q*, of the eccentric pin-wheel, U. E, is a click, mounted on a centre-pin at *o*, and urged constantly towards the plate, M, by a spring, *p*.

Now the operation of these parts in producing the effects which I have stated as being the object of the said invention, is as follows:—Suppose the reel to be empty, and the machine just ready to start to wind on a set of skeins; the handle being turned round, the reel, *g*, will begin to turn in the direction of the arrow, fig. 2. The wiper, R, will, at starting, be in the position there shewn, that is, just above and clear of the tooth, L, of the lever, I, H, L, which is kept in that position by the spring, *l*, just clear of the wiper, R, so that it can revolve with the wheel, A, without catching the tooth, L. The laying of the first set of skins now begins, and proceeds by the rotation of the reel; and the eccentric pin-wheel, U, the centre of which is mounted in the sliding-plate at *q*, as aforesaid, is regularly turned round by the reel, by means of the three wheels hereinbefore mentioned, to give the traversing or jogging-motion to the layer, and lay the threads evenly on the reel in the skeins, Nos. 1, fig. 1.

The motion of the reel also sets the train of regulating wheel-work in motion, and by the time the reel has made 3000 turns, and the wheel, D, one quarter of a turn, or, strictly speaking, a little before that, the tooth, K, is caught by one of the chocks of the wheel, D, which presses against that tooth, and so draws the lever, I, H, L, in towards the centre of the wheel, A, so as to bring the tooth, L, within the range of the wiper, R, which comes round and catches the said tooth, and lifts up the lever, I, H, L, at the moment that the reel has completed 3000 turns, in order to carry the threads away from the skeins, No. 1, (which contain the proper length of thread,) and shift them a space along the reel, to begin laying the skeins, No. 2.

This change of position of the threads is effected as follows:—When the lifting-lever, I, H, L, is lifted as aforesaid, the pin, *m*, which is fixed into it at the upper part,—see fig. 2,—and which rests in the lowest notch of the sliding-plate, M, catches against the upper part of that notch, and raises the plate, M, until the click, E, drops into the first notch, Q. (Note—a grove is cut in the frame, 7, 7, to allow the pin, *m*, to move up and down in.) Now as the centre-pin of the eccentric pin-wheel, U, is mounted in the sliding-plate, M, the latter, in rising, carries up the eccentric pin-wheel with it, and hence it moves (by means of the vertical rod, and rails, 2, 3, and 4, above described), the layers, 5, 5, endwise, so as to shift the guides and threads the required space along the reel, and bring them opposite to the places for the skeins, No. 2.

The laying of the skeins, No. 2, now begins, and goes on exactly as the laying of the skeins, No. 1, did, the eccentric pin-wheel, U, mounted on the pivot, *q*, being turned by the reel as before, and giving the proper traversing or jogging-motion to the layers or guide-rails; during all which time the tooth, K, having been quitted by the first chock of the wheel, D, the lever, I, H, L,

remains in such a position that the tooth, L, is clear of the wiper, R, and allows the latter to revolve without lifting the lever. When the wheel, D, has nearly performed a second quarter of a turn, a second chock on it catches the tooth, K, and again throws the lever, I, H, L, forward enough for the tooth, L, to be caught and lifted up by the wiper, R. The lever will then be lifted up a second time, and lift the sliding-plate, M, by means of the pin, *m*, till the click, E, drops into the second notch, Q. The second rise of the plate, M, by raising the axis of the eccentric pin-wheel, U, shifts the guide-rails again, so as to bring the threads opposite the places for the skeins, No. 3, which are then laid as the former ones were. This operation of the regulating wheel-work, and the parts on which it acts, is repeated a third time, in order to shift the threads again, and lay the skeins, No. 4, which will be completed by the time the reel has made its 12,000 turns, and the wheel, D, one revolution; the sliding-plate being raised one notch, Q, every time one of the chocks of the wheel, D, has operated on the tooth, K, and the reel having taken up 3000 turns of thread, to form each of the skeins, Nos. 1, 2, 3, and 4, between every two operations of the wiper, R, on the tooth, L. The last chock of the wheel, D, operates so as to throw the tooth, L, over the wiper, R, just when the last set of skeins, No. 4, has been completed. The lever, I, H, L, is then caught and raised a fourth time by the wiper, R, in order to stop the machine. This is effected by means of the lever, O, F, which is poised on a centre at *s*, the end, O, being linked to the lever, I, H, L, and the end, F, being connected by a link, F, G, and a chain or cord, to the end of a bent spring-bar, *a*, see figs. 2 and 3, (which last represents a section of one of the uprights of the frame of the machine.) A mortice is cut through each of the said uprights, and a long bar, A, A, *b*, *b*, lies across the machine in those mortices, each end of the bar resting upon a bent spring-bar, *a*, (see fig. 2), and projecting out

through the mortices beyond the frame, where it is loaded with a weight, *b*. In the middle of the bar, A, A, is an open collar, (see also fig. 5,) which incloses two clutch-bars or levers, C, D. These clutch-bars are moveable about centre-pins, at *t*, *t*, fixed in the broad end of the axis, B, of one of the drums, *e*. Their lower ends are formed into forks, and rest upon a curved bar, *u*, fig. 2, and fig. 5, keyed to the axis, B, and their upper ends, D, D, are pressed inwards towards the centre of the axis, B, by means of the springs, R, R, so as to catch into corresponding cavities or boxes, formed in the boss of the pinion, *d*, so long as the bar, A, A, is in the position, fig. 5, *videlicet*, at the upper part or near the pivots of the clutch-bars, C, D; that is, so long as the bar, A, A, is supported by the bent spring-bars, *a*, *a*. Now all the time that the machine is at work, the bar, A, A, is kept in that position, because the upright springs of the spring-bars, *a*, *a*, keep the horizontal part (see fig. 3) under the ends of the bar, A, A: but every time that the lever, I, H, L, is lifted up, it raises the end, O, of the lever, O, F, fig. 2, and so depresses the other end, F, and by means of the link, F, G, and chain, draws the spring-bar, *a*, at the right hand of the machine outwards a little, but it does not draw it out quite clear of the bar, A, A, until the lever, I, H, L, is lifted for the fourth time, which takes place, as aforesaid, as soon as the wheel, D, has completed one revolution, and the reel has taken up four sets of skeins. At that instant the bent spring-bar, *a*, at the right hand end of the machine is pulled out by the fourth depression of the end, F, of the lever, O, F, quite clear of the bar, A, A, the right hand end of which drops by the weight of its ball, *b*, and the collar sliding down on the curved or spreading ends, C, C, of the clutch-bars, compresses them and brings them together, and thus causes the upper ends, D, D, to open outwards and quit their boxes in the boss of the pinion, *d*, whereby the axis, B, is thrown out of gear with that pinion, and the ma-

chine is stopped. In order to start the machine again, the bar, A, A, is lifted up again into the position, fig. 2, by raising the right hand lifting-rod or sliding-bolt, C, which is fastened to it. Note—The end of the bar, A, A, the left hand of the machine, rests also upon a bent spring-bar, *a*, as shewn in fig. 2; but it is not necessary that it should be drawn out by the operation of the machine to stop itself, as the dropping of either end of the bar, A, A, is sufficient to stop the machine: but the attendant can stop the machine at any time, if requisite, by drawing out the bent spring-bar, *a*, at the left hand of the machine, and throwing down that end of the bar, A, A, without deranging the positions of the lifting-lever and sliding-plate; so that the machine when started again, will take at the point where it left off. And note, also, that care must be taken in fixing the hereinbefore described mechanism, to adjust the proportions of the wiper, R, and of the chocks on the wheel, D, and their positions in respect to the teeth or catches on which they are to operate, so that the said chocks will throw the lifting-lever forward over the wiper, R, and the wiper, R, catch it and lift it up, just when the reel has made every 3000 turns, and in the intervals, that is, while the skeins are being laid, the tooth, L, must remain clear of the wiper, R, as it revolves; because if the chocks are too soon or too late in taking on to the tooth, K, they will of course cause irregularities in the length of the skeins. And so, the wiper, R, must be adjusted to catch the lever, I, H, L, just when the chocks of the wheel, D, respectively, have operated upon it, and lift it the right heights for the spaces between the skeins. But the parts being once adjusted, the machine, once started, will go on regularly of itself, laying four skeins and 3000 turns of the reel in each, or within a fraction thereof.

In the foregoing description, I have made no mention of the twist of the threads, in passing from the bobbins to the reels. The machines described in reference to

figs. 1 and 2, may be used with the said improvements, applied to them either as simple winding-machines, whether the bobbins be filled with silk of a single thread twisted, or with silk doubled and twisted, or with any other threads that it may be desired to wind on reels, in skeins containing a regular length of such thread; or they may be used as silk throwsting-machines, the bobbins being furnished with suitable flyers, of the usual kind, fixed to the spindles, and turned round by the bands, *i*, *i*, with a proper proportion between their speed and the rate at which the silk is drawn off the bobbins, to give the requisite twist to the silk.

And note, also, I have described the machine, figs. 1 and 2, as having two reels, and two sets of bobbins; but it may be made with only one, as is usual in winding or throwsting-machines, placed in the middle of the machine. When a thread breaks, the length of the skein that it was forming will of course be different from the rest, unless the machine be stopped to piece the two ends together, which may sometimes be found inconvenient. In that case, the workman must mark the skeins where a thread has broken, and when he removes all the skeins, he must put the incomplete ones on rails or bobbin-wheels, T, fig. 6, of the size of the skeins, with more silk. These bobbin-wheels, T, are then taken to another winding-machine, like the machine, figs. 1 and 2, and furnished with a train of regulating machinery, a lifting-lever, and a sliding-plate, and other parts requisite for regulating the number of skeins wound off each bobbin-wheel, T, and the number of turns of the reel contained in each skein, so that the workman can fill the said fresh reel with skeins of the regular length, made up of the imperfect skeins that came from the other machines, and the requisite additions of fresh silk. But I prefer fitting up winding or throwsting-machines made with the said improvements, so that if a thread breaks, the machine shall stop itself, and give notice to the at-

tendant to piece the broken ends together, before he sets it to work again. In order to do this, I place behind the layer or guide-rail a horizontal frame, F, *h*, H, fig. 7, resting in bearings by its two end-pivots, F, H. This frame is so constructed as to balance itself exactly on each side of the centre, so that it remains in the position shewn by the dotted lines unless thrown out of balance by some force. A click, *i*, projects out from the axis, F, H, towards a ratchet-wheel, E, on the axis of the reel, but does not touch it, while the frame, F, *h*, H, is horizontal, as shewn by the dotted lines. The guides or wires are fastened to a long spindle resting in sockets attached to the layer-rail, and the upper ends of the wires are loaded with very slight weights, which would throw them backward if they were not supported. Now while the work is going on regularly and properly, the tension of the threads will support the guides and prevent their falling back; but if any thread breaks, the weight at the upper end of its guide, being no longer held up, tilts the wire backwards, and it falls down on the frame, F, *h*, H, and throws it down from its horizontal position into the position drawn in full lines in fig. 7. In so falling, the frame, F, *h*, H, throws up on the opposite side of its centre of motion, its click, *i*, which catches against one of the teeth of the ratchet, E, and sets it fast. The whole machine is thus stopped, and cannot be started again until the broken thread is mended, and the ratchet, E, released, by replacing the frame, F, *h*, H, in its horizontal position.

When a winding or throwsting-machine, fitted with the said improvements, is thus constructed to stop itself if a thread breaks, I drive the reel by friction from a drum, B, (which receives suitable motion from the first moving axis) and bears against the circumference of a drum, A, on the axis of the reel, to turn it round by friction; hence when the reel is stopped by the click, *i*,

the drum, B, can continue turning, and will slip on the circumference of the drum, A, instead of turning it.

Having now described the nature of the said improvements on, or additions to, machinery for throwing or winding silk or other threads, I do hereby declare that I claim, as the said invention, the train of regulating wheel-work, hereinbefore described, acting in combination with the lifting-lever and sliding-plate, upon the eccentric pin-wheel, that gives the usual traversing-motion to the layer; and acting by means of the lever, O, F, and the tackle connected therewith, upon the bar, A, A, and the clutch-bars, C, D; in order to regulate the number of coils or laps of thread that shall be wound round the reel to form each skein; and to shift the layer or guide-rail endwise, at stated and regular intervals, to lay several skeins from one bobbin; and also, to throw the axis of the reel out of gear with the driving-pinion, and stop the machine when the required number of skeins has been laid. But I do not confine myself to that precise construction of the parts which transmit the operation of the said regulating wheel-work, to produce the effects above stated, provided the essential features of the said improvements, as hereinbefore described, be not departed from. Neither do I confine myself to those precise proportions of the train of wheel-work, which cause each bobbin to lay four skeins of thread, as the said train may be proportioned to lay a greater or less number of skeins from each bobbin, the other parts being made to correspond.—In witness whereof, &c.

Enrolled March 19, 1834.

Specification of the Patent granted to GOLDSWORTHY GURNEY, *of Bude, Cornwall, Esquire, for certain Improvements in Musical Instruments.*—Sealed October 18, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the drawing hereunto annexsd, and the following description thereof (that is to say):

Description of the Drawing.

In my said invention of certain improvements in musical instruments, that, instead of wire strings, straight rods, or strings, I employ glass, or metal bars or rods, whether of steel, iron, copper, brass, or of any other metal, or compositions of metals, or alloys, which may be fit and proper for the purpose, and which said bars or rods I curve or bend at a certain point or points, which is or are equidistant from the ends of the said bars or rods, into the figure, shape, or form shewn at C, C, in fig. 1, and secure it in front of a bridge or bar of wood or metal, B, glued to or affixed in front of a sound-board or resonant-board, A, A, (shewn in section,) in the following manner. A hole is made through the bridge, B, and sounding-board, A, through which the two ends of a metal wire or string are passed, after having been bent over the centre of the bent bar or rod, C, to the back of the sound-board, as shewn at P. A steel spring, Q, about six inches long, and an eighth of an inch square, is placed upright against the back of the sound-board, A, A, and the ends of the wire or string are twisted or tied together over it. One end of the spring, Q, is then drawn away from the sound-board, the other end still resting against

it, until a sufficient tension or binding-action is produced by the wire, to affix the bent rod or bar, C, C, against the front of the bridge, B, when a wedge, R, must be introduced between this end of the steel spring, Q, and the sound-board, to preserve or continue a uniform tension, sufficient to prevent the bent bar or rod, C, C, from shifting its position, when struck by the hammer, in the manner now to be described. L, is a hammer hinged to a rail, H, and raised by a hopper, K, affixed on the end of the lever or key, G, and which said key is to be acted upon by the finger of a performer, in the manner of playing the piano-forte or organ, when the said hammer strikes the end of one leg of the rod, C, C. A piece of wood, U, is placed under the end of the hammer to give it weight, the size of which is regulated according to the size of the rods employed, at the will of the manufacturer, so as to bring out a tone most desirable in his judgment. The head, S, of the hammer, L, is to be covered with cloth, soft leather, or, which is preferable, with a layer of caoutchouc or Indian rubber, of about a sixteenth of an inch in thickness, or more or less, according to the taste of the manufacturer. The rail, H, is affixed between screwed nuts, upon the upper end of a screwed wire or rod, O, which is passed between the keys, and affixed to the key-board, T, of the instrument, in the usual way of piano-forte makers. If dampers, to shorten the time of vibration of the bars or rods, C, C, are required or desired by the manufacturer, they may be affixed in the following manner. D, is a damper, hinged to the upper edge of the rail, F, and shewn as resting upon the bar or rod, C, C; it is elevated or lifted off the rod, in playing, by means of a connecting-rod, E, hinged to the damper, D, and resting in a notch or gap, formed to receive it, on the upper face of the stem of the hammer, L.

Having thus described the manner of affixing and the mode of striking and damping one vibrating or sounding-rod or bar, C, C, I now declare that every rod or bar in

succession may be affixed and acted upon in a similar manner, downwards to the bass, and upwards to the treble, throughout the whole compass of the instrument; and which compass may be limited or extended, more or less, from six octaves. The size of the bent rods or bars, c, c, may be varied, in order to produce different qualities of tone, at the will of the manufacturer: the sectional form of them may be either round, oval, square, flat, or of any other shape or form required. These different sectional shapes afford somewhat different qualities of tone, either of which may be employed at the pleasure of the manufacturer. Those which I now employ, are made cylindrical, and about one quarter of an inch in diameter in the bass part of the instrument, and gradually becoming smaller and shorter towards the treble, terminating in about one-eighth of an inch in diameter. Their lengths depend on their sectional size, the kind of metal, and the pitch required. Those above described are steel, and about two inches and a half in length, in the highest note of the treble, and increase in length gradually towards the bass; the lowest note of which is about twenty inches long, the instrument having the compass of six octaves. The curvature or bending of each bar or rod, c, c, opening or widening towards the bass, more or less, according to the ear or taste of the manufacturer, or agreeably to the louder or softer quality of tone required. The rods or bars are tuned by filing their ends so as to shorten their lengths, by which means their tones become higher in pitch; or the tone may be flattened or lowered in pitch, by filing the heel or central point of the bend of the rods or bars, c, c, thinner.

The great improvement effected in this instrument consists in substituting curved bars or rods, c, c, for stretched or strained wires, tuning-forks, or straight bars, rods, or plates, as used in the various musical instruments, now or heretofore invented or in use. Glass rods or bars must be curved, and mounted in a similar

manner to the metallic ones, when preferred, only they will be required to be increased in diameter.

Having thus described the manner of carrying my said iuvention into effect, I declare that I do not mean or intend to claim as my invention any of the various parts which may have been already known or in use; but only the manner of adapting them to my said invention, and which invention consists in the application of the aforesaid curved rods or bars of glass, metal, or alloys, or mixtures of metals, in the manner herein described, to the improving of musical instruments. — In witness whereof, &c.

Enrolled April, 7, 1834.

Specification of the Patent granted to JOHN RAMSEY, *of Caroline Place, Mecklenburgh Square, in the County of Middlesex, Esquire, for certain Improvements in Apparatus for turning over the Leaves of Music and other Books.*—Sealed February 26, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said John Ramsey, do hereby declare the nature of my invention and the manner in which the same is to be performed and carried into effect are fully described and ascertained, in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

My invention consists in combining certain mechanical movements and apparatus into an instrument or machine for turning over the leaves of music and other books, as will be hereafter fully described.

Ramsey's Patent.

Fig 1

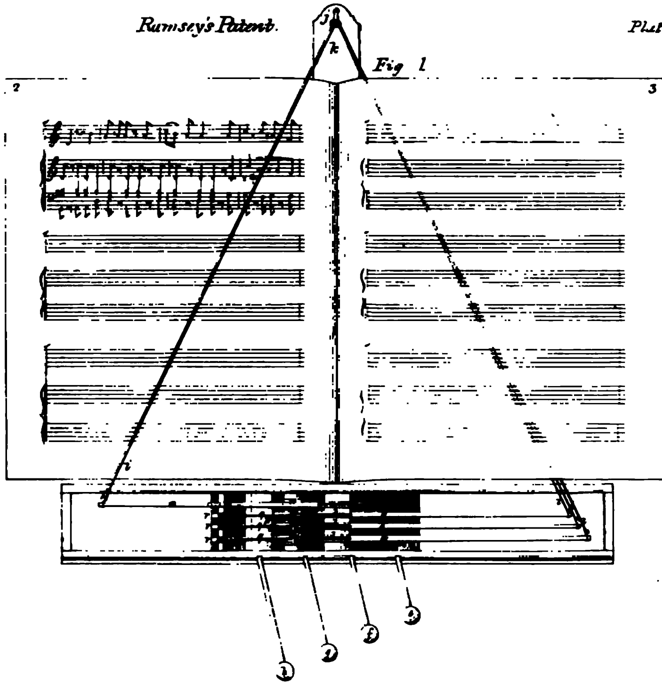


Fig 2

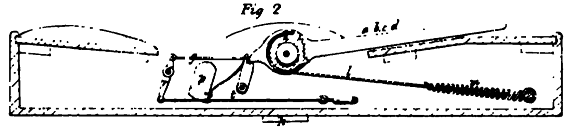
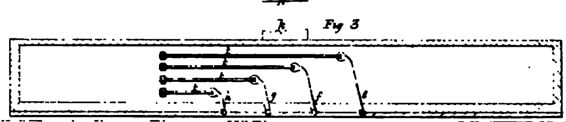


Fig 3



Youldon's Patent

Fig 1

Fig 5

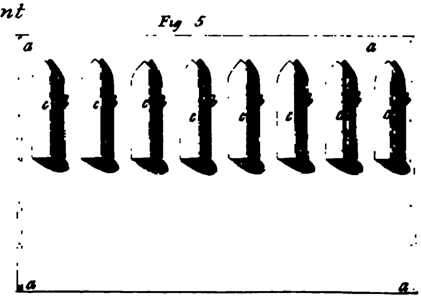


Fig 2

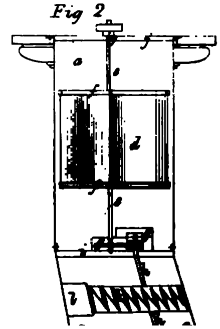
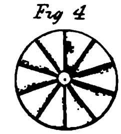


Fig 3

Fig 4



Description of the Drawing.

Fig. 1, shews a front view of an instrument complete, constructed according to my invention.

Fig. 2, is a longitudinal section of fig. 1, taken at the dotted lines, from front to back of the instrument or machine: and

Fig. 3, is another longitudinal section, removing all the front parts, in order to shew those parts which are at back. In each of these figures the same letters of reference indicate similar parts. *a, b, c,* and *d,* are four levers, turning on an axis, affixed from top to bottom of the box which contains the various movements of the instruments. The construction of this box will be evident by inspection of the various figures in the drawing. *e, f, g,* and *h,* are four cranked wires, which act as triggers for removing the stops hereafter mentioned, when a leaf is to be turned over. These cranked wires turn in holes at the bottom of the box, and act on the levers, *a, b, c,* and *d;* that is to say, the cranked wire, *e,* when moved, releases the lever, *a;* the cranked wire, *f,* releasing the lever, *b;* the cranked wire, *g,* releasing the lever, *c;* and the cranked wire, *h,* releasing the lever, *d,* as they are respectively acted on. *i, i,* are silk or other cords attached to the ends of the levers, *a, b, c, d;* and these cords are also attached to the hook, *j,* at the upper end of the standard, *k,* which standard is connected to the back of the box, or to a part of the ordinary music-stand, which acts as a book-rest, whether for music or otherwise. *l, l,* are cords of gut or other suitable material, one to each of the levers, *a, b, c,* and *d.* These levers, *l, l,* are each attached to a separate spring, *m,* and also pass partly round the end of the levers, and are affixed within a groove, as is clearly shewn in figs. 1 and 2. *n, n,* are stops or catches, which turn on axes, and are pressed on by the springs, *o,* as will be clearly seen in fig. 2. At the top of each of these catches or stops is

formed a notch which retains the ends of the levers, *a*, *b*, *c*, or *d*, when placed on the right-hand side of the instruments, and consequently ready to be thrown from right to left when turning over the leaf of a music or other book. *p*, is a bar affixed from top to bottom of the box, to which the springs, *o*, are attached. *q*, *q*, are connecting-rods, which connect the stops, *n*, *n*, to the cross-heads or levers, *r*, which turn on axes affixed from top to bottom of the box, as shewn by the drawing. *t*, are the connecting-rods which connect the cranked wires, *e*, *f*, *g*, and *h*, with the cross-heads or levers, *r*.

Having thus described the various parts, I will proceed to explain the manner of action, referring more particularly to fig. 1. In order to use this invention, it is to be placed as a book-rest to a piano-forte, and affixed thereto. A book having been placed on the top of the box which contains the various movements and apparatus. The cords, *i*, *i*, are to be unhooked either from the levers, *a*, *b*, *c*, and *d*, or from the hook, *j*, and passed between successive leaves of the music-book, and then again hooked either to the levers or to the hook, *j*, as the case may be. The levers, *a*, *b*, *c*, and *d*, are then to be placed on the right hand side, by which the stops, *n*, will catch against the ends of their respective levers, *a*, *b*, *c*, and *d*, and hold them, till by moving the cranked wires, *e*, *f*, *g*, *h*, in succession, the levers, *a*, *b*, *c*, and *d*, will be successively thrown from right to left, taking with them the leaves of the book, by means of the cords, *i*. I would here remark, that although I have only shewn one description of spring, *m*, for actuating the levers, *a*, *b*, *c*, and *d*, it will be evident that other springs may be used: and I would also remark, that although I have shewn the instrument as applicable to a rest for a music-book, and described it as to be attached to a piano-forte, it will be evident that it may be applied to a music-stand, or to a table, for supporting a book whilst reading. When it is desired to turn over a leaf, the balls on the crank wires

are to be pressed from right to left, by which the stops, *n*, will be removed, and by the collapsing of the springs, *m*, the levers, *a*, *b*, *c*, and *d*, will be thrown from right to left and turn over the leaves. It will be evident from the above description, that in place of having the balls or knobs at the ends of the cranked wires, *e*, *f*, *g*, *h*, such wires may, to music stands and in other convenient situations, be carried down to such a position as to be acted upon by the foot in place of the hand.

Having now described the nature of my invention and the manner of carrying the same into effect, I would have it understood that I lay no claim to any of the parts separately, more particularly the parts, *a*, *b*, *c*, *d*, similar parts having been before used for a like purpose: but what I claim as my invention is the combining of the various mechanical movements and apparatus into an instrument or machine for the purpose of turning over the leaves of music and other books, as above described. —In witness whereof, &c.

Enrolled August 22, 1834.

Specification of the Patent granted to EDMUND YOULDON, *of Exmouth, Schoolmaster, for Improvements in Preventing or Curing what are termed Smokey Chimneys.*—Sealed August 5, 1834.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Edmund Youldon, do hereby declare the nature of my said invention and the manner in which the same is to be performed are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

Description of the Drawing.

Fig. 1, represents an apparatus constructed according to my improvements.

Fig. 2, is a vertical section thereof.

Fig. 3, is a transverse section thereof: and

Figs. 4 and 5, shew detached parts of the same. In each of these figures the same letters of reference indicate similar parts, *a*, being the outer casing of zinc or other suitable material. *b*, *b*, are openings formed for the passage of air and smoke: these openings are covered in one direction, by the curved plates or wind-guards, *c*, *c*, the object of which will be hereafter described. *d*, *d*, are four curved vanes affixed to the axis or shaft, *e*; these curved vanes are also affixed to the hoops or stays, *f*, *f*, for the purpose of keeping them in their proper positions as shewn in the drawing. The shaft or axis, *e*, turns in bearings at *g*, *g*, there being a box or cover to prevent the smoke or dirt getting to the point of bearing. On to the axis, *e*, is affixed a toothed wheel which takes into and drives the pinion on the shaft, *h*, which also turns in bearings at the points, *g*, *g*, as shewn in the drawing, these bearings being supported by the cross framings, *i*, within the casing, *a*, and the upper one by the cover, *j*, for it will be seen that there is no passage for the air and smoke to pass at top, other than by the openings, *b*, *b*, which I prefer should be the case. On the axis *h*, is affixed a circular fan or wheel, *k*, shewn separately at fig. 4: this circular fan is constructed similarly to those used for smoke-jacks and for ventilators. *l*, is a stop which fills up that part of the outer casing, *a*, which is not occupied by the fan-wheel, *k*, and thus is prevented the passage of smoke except between the vanes or spokes of the fan-wheel, *k*.

Fig. 5, represents a plate of zinc, which is the material I commonly use, but do not confine myself thereto, as any other suitable material may be employed. This

plate of zinc has eight openings, *b*, formed therein, whilst the part of the metal which is cut to form the opening is curved, as shewn in the drawings, and thus form wind-guards to the openings, by which the wind is prevented entering such openings, excepting in certain directions, by which means only about three of the openings will be open to receive the wind, whilst the other openings may be said to be the tail part of the mill, through which the wind that actuates the vanes, *d, d*, will again pass off, carrying with it any smoke which may be in the upper part of the apparatus.

Having thus described the various parts of the apparatus, I would remark, that it will be evident that the wind, in whatever direction it may blow, will be entering some of the openings, *b*, and thereby actuating the vanes, *d*, and cause the axis, *e*, to turn, and by the wheel-work give an increased motion to the fan-wheel, *k*, on the axis, *h*, and the vanes being set in a proper direction, will by its rapid revolution create an exhaustion below and a consequent draft to the chimney on which this apparatus is fixed. I would also remark, that I am aware that fan-wheels have been before used similar to the one I have described for producing a draft in chimneys, I do not therefore claim the production of a draft by such means, and it will be desirable to state that I do not lay claim to any of the parts separately, nor do I confine myself to having two shafts for the vanes, *d*, and the fan, *k*, as it will be evident that they may be both attached to one, though I prefer that the fan-wheel, *k*, should have a faster revolution than the vanes, *d*, as above described.

Having now described the nature of my invention and the manner of using the same, I would have it understood that what I claim as my invention is the combining the action of the vanes, *d*, with the fan-wheel, *k*, whereby the wind in giving motion to the vanes, *d*, cause the fan-wheel, *k*, to create an exhaustion below it, and a consequent draft up the chimney, and thus prevent or cure

what are termed smokey chimneys.—In witness whereof, &c.

Enrolled October 4, 1834.

LAW REPORTS OF PATENT CASES.

Court of Chancery, November 14, 1834, *before the Lord Chancellor.*

CROSSLEY *v.* THE DERBY GAS COMPANY.

IN this case a bill was originally filed by the plaintiff in the Vice-Chancellor's court, praying that the defendants might be restrained from manufacturing gas-meters according to the plaintiff's patent; and further praying an account, claiming to have the profits which would have accrued to the patentee under his patent, had he made the meters which the defendants had manufactured.

The Vice-Chancellor gave judgment in favour of the patentee as prayed.

The present was an appeal to the Lord Chancellor (Brougham) against that decree.

His Lordship, in giving judgment, said he thought that, after the validity of the plaintiff's patent had been established in the action against Beverley*, that point could not be raised, under the circumstances which this case presented, upon the present appeal. Whether the account ought to be as had been directed was a different question, and it was to that his lordship should turn his attention. It was a principle in courts of equity, that a party who claimed a right should not lie by, and by his silence or acquiescence indúce another to go on expending his money and incurring risk, and afterwards, if profit had been made, come and claim a share in that profit,

* The patent had been tried in a court of common law in England, and also in Scotland; in both instances the patent was held to be good.—ED.

without ever having been exposed to share in the losses which might have been sustained. Upon this principle the defendants relied. It was to be considered, on the other hand, whether the plaintiff did not explain the delay which had taken place, and whether the conduct of the defendants, who denied his right, had not been such as to lull his suspicions to sleep.

His lordship adverted to the fact of the bill having been filed shortly before the expiration of the patent, and to the delay which had taken place in suing for the relief he now claimed. On the other part of the case he thought the objections taken to the specification were not sustained by the evidence, and that the validity of the patent must be taken to be established. The objection of the delay threw upon the plaintiff the necessity of explaining it. It appeared that in 1821 the defendants had bought two of his meters, that afterwards they had paid him for a licence on another meter, and that they had applied to him for a badge to put on such meter. They had prevented any person from having access to the manufactory in which the meters were made, and they had all along denied that they had committed any infringement on the plaintiff's patent. It appeared also that the invention was not profitable till 1824, and that from that period to the filing of the bill the plaintiff had frequently consulted his solicitor, but that it was not till 1829 that he obtained sufficient evidence of the defendant's infringement of his right. He then filed the present bill. Now, upon these facts his Lordship thought the delay was explained, and therefore that the decree of the Vice-Chancellor must be affirmed, and with the costs of this appeal.

Court of Exchequer, Westminster, November 7, 1834, *before the Lord Chief Baron Lyndhurst, Mr. Baron Alderson, Mr. Baron James Parke, and Mr. Baron Gurney.*

MINTER *v.* WELLS and ANOTHER.

IT will be remembered that this was an action* brought by the plaintiff against the defendants for having infringed his patent, and was tried before Mr. Baron Alderson, at the sittings after last term, when a verdict was given for the plaintiff.

Mr. Godson (for the defendants) now applied to the court for a rule to shew cause why this verdict should not be set aside and a nonsuit entered.

The Lord Chief Baron.—What is the ground of motion?

Mr. Godson.—The specification claims for a principle only.

The Lord Chief Baron.—The objection is then to the specification?

Mr. Godson.—Yes, my lord. Though I would first state, that in this model of the plaintiff's chair your lordship will observe some iron plates nearly at the bottom of the back of the chair, which moves so as to lift up the seat. Those iron plates are not in the defendants' chair. This is the only point for which it will be necessary that the defendants' chair should be looked to. I draw your lordship's attention to this fact, because in the plaintiff's specification he says, "It is by the application of these plates, *g*, *g*, *h*, *h*, by which the object of my invention is obtained;" so that the object of his invention being obtained by those two plates, if he depend on the mechanical means described, then we have not taken those plates which produce the effect. This objection was taken at

* For the trial see Repertory, vol. ii., new series, p. 80; and for the specification, vol. xii., third series, p. 68.

the trial, but was overruled by the learned judge, who observed, "I think the invention claims the self-adjusting principle:" and, accordingly, the defence was conducted upon that intimation, that the patentee was claiming for the principle—

Mr. Baron Alderson.—Carried into effect by certain mechanical means as applied to chairs.

Mr. Godson.—But the defendants did not use the same mechanical means which the plaintiff found out and used.

The Lord Chief Baron.—Then the truth is, it comes to this after all—Is it a colourable evasion of those mechanical means?

Mr. Godson.—My lord, I am not going upon the evidence taken at the trial, but am only endeavouring to shew that the patentee claims the principle and not the means. Either the plaintiff by his summing up has claimed the principle and expects to keep a monopoly of the principle, whatever means are used to carry it into effect, or else he claims only the means which he has specified.

The Lord Chief Baron.—It must be substantially those means. It is not confined strictly to the means he has pointed out.

Mr. Baron Alderson.—If I remember rightly, Mr. Pollock, who led for the plaintiff, produced a skeleton of the leverage of the plaintiff's chair, which, by just reversing it, became the defendants' chair.

Mr. Godson.—I am not moving that it was not an infringement if he is entitled to the principle. But if he claims the principle, I think I shall satisfy your lordships he is not entitled to do so. If, however, your Lordships are of opinion that he claims only the mechanical means, then we say we have not taken those mechanical means.

The Lord Chief Baron.—He says, "what I claim as my invention is the application of a self-adjusting leverage to the back and seat of a chair, whereby the weight on the seat acts as a counterbalance to the pressure

against the back of such chair, as above described." That is what he claims,—a self-adjusting leverage acting in that way. Then he points out the particular method by which that is effected. The question therefore is, whether you have infringed that method.

Mr. Godson.—If your lordship will read two lines further back in the specification, you will find that he does not confine himself to that. He says, "I lay no claim to the separate parts of the chair which are already known and in use, neither do I confine myself to making them in the precise shapes or forms represented"—

The Lord Chief Baron.—"But I claim"—

Mr. Godson.—I am only using this as an argument to shew that he has claimed a principle, and that is only the using of a common lever. If he is permitted, under that claim, to have the sole use of it, he is in fact taking a mere bent lever in such manner that the shoulders of the person acting on one end, he sitting on the other end, the parts of the chair are equally poised: it is nothing more than a common balance—a common scale. The learned judge at the trial of the cause had remarked, that "the essence of the plaintiff's claim is a self-adjusting leverage. If it could be shewn that a self-adjusting leverage was so applied to a chair before the plaintiff's patent, he is not entitled to retain it;"—clearly shewing that the claim was for the self-adjusting principle, and thus he would appropriate to himself a first principle. Now I need not quote cases to your lordship to shew that it has been clearly settled that he cannot do that. The consequences must therefore be evident. He says, "I lay no claim to the separate parts of the chair which are already known and in use, neither do I confine myself to the making them in the precise shapes or forms represented;"—clearly intimating that he claimed to have the self-adjusting principle, in whatever manner it may be made by any mechanical man. The question therefore comes to this—has he summed up the whole of his invention so as to

shew that he has claimed a self-adjusting principle, then the self-adjusting being one of the first principles in mechanics, is he entitled to a monopoly of the use of that to himself?

Mr. Baron Alderson.—All the witnesses proved that there never had been a self-adjusting leverage used in a chair before.

Mr. Godson.—Yes, my lord, I admit that;—and admitting that, in fact, it comes to the question whether that could be the subject of a patent.

The Lord Chief Baron.—He says, I claim the application of a self-adjusting leverage to the back and seat of a chair, so as to produce such and such an effect.

Mr. Godson.—Yes, my lord, that effect being nothing more than the motion of a lever backwards and forwards producing such an effect.

The Lord Chief Baron.—It is the application of a self-adjusting leverage to the back and seat of a chair, he having described what self-adjusting leverage was before.

Mr. Godson.—Your lordship sees if you go into that part of the description, then I say we have not taken the means by which he carries it into effect.

The Lord Chief Baron (having the model in his hand). —It is only turning it upside down.

Mr. Baron Alderson.—The thing which was exhibited before the jury was just reversing the parts, and then it would be exactly a *fac simile* the one of the other.

Mr. Godson.—Your lordships will perceive it is nothing more than a common lever, the fulcrum being just at the back of the chair; and if he is entitled to sum up this principle, and maintain this patent, no person can hereafter, till the fourteen years have expired, apply a lever in this way. Your lordships will see this is a very important patent to the trade, as well as to the parties to the suit; and it is necessary you should settle it between them. It comes before your lordships not as a question

of fact, but only as to whether the specification is good or bad.

The Lord Chief Baron.—Any application of the self-adjusting principle to the back and seat of a chair producing this effect—that the one acts as a counterbalance to the pressure against the other—would be an infringement of this patent, but nothing short of that.

Mr. Godson.—Yes, my lord; and, therefore, every application of a lever to the back of a chair would be an infringement.

The Lord Chief Baron.—No; a self-adjusting lever.

Mr. Godson.—Yes, my lord; but every lever is self-adjusting.

Mr. Baron Alderson.—No, no; that is what you tried before.

Mr. Godson.—He has claimed, by the specification, the use of the lever, for fourteen years, to the backs of chairs.

The Lord Chief Baron.—It is not a leverage only, but the self-adjusting leverage; and it is not the self-adjusting leverage only, but it is the self-adjusting leverage producing a particular effect, by the means of which the weight on the seat counterbalances the pressure against the back.

Mr. Godson.—Exactly so, my lord; that is, in other words, a lever. It is not self-adjusting excepting by applying of the weight at each end.

The Lord Chief Baron.—It is so contrived that the fulcrum varies as the pressure varies.

Mr. Godson.—No, my lord.

The Lord Chief Baron.—The pressure varies.

Mr. Godson.—The pressure only varies according as you move one end or the other. If you move your shoulders you go back, so that it is nothing more than a common lever steelyard.

Mr. Baron Alderson.—It is a very beautiful and ingenious invention, Mr. Godson, certainly.

The Lord Chief Baron (reading from the specification).—"The parts, *h*, *h*, support the back of the chair in any position, and it will be evident by the passing or advancing of the parts, *h*, *h*, along the curved ends, *i*, *i*, they will approach the weight on the seat, *b*, and thereby shorten the leverage, and consequently lessen the action of such weight" without an effort.

Mr. Godson.—Yes, my lord; that is, the back of the chair is the one end of the arm, the part that is under the other arm; and according as you apply the weight here, the one goes down; if you apply the weight to the other arm, then that comes up: and, therefore, my lord, I am contending, that inasmuch as he has summed up and says this patent is for a principle—

The Lord Chief Baron.—You are using the word "principle" in a loose sense.

Mr. Godson.—The word principle certainly has never been very accurately defined, as applied to inventions, but it has never been doubted, that if you take one of the first principles in any science—for instance, the lever in mechanics—you cannot secure it by patent.

The Lord Chief Baron.—This is a mechanical contrivance.

Mr. Godson.—Yes, my lord; it is nothing more than one of the first principles.

Mr. Baron Parke.—But that not being applied in combination before, can that not be patented?

Mr. Godson.—No, my lord; I apprehend not. If he claim the combination, and then sums up the invention for the principle, and not for that combination—

Mr. Baron Parke.—It is only for the application of the self-adjusting leverage to a chair. Cannot he patent that?

Mr. Godson.—If that were so, then the words in which he makes his claim are bad.

Mr. Baron Parke.—But his patent is the application of a self-adjusting leverage to a chair, which is admitted

to be a new combination. Cannot that be the subject of a patent? It is the combination of the two things which he claims as the subject of the patent.

Mr. Godson.—If your lordship thinks that that construction can be put upon it, that is quite another question.

Mr. Baron Parke.—He claims the combination of the two,—no matter in what shape or way you combine them.

Mr. Godson.—What is the combination?

The Lord Chief Baron.—Why the application of the self-adjusting leverage producing the effect, constitutes the machine; and he claims that machine, and the right to make that machine.

Mr. Godson.—If your lordship translate this to mean machine, of course I have no further argument to use.

The Lord Chief Baron.—It is evidently a machine consisting of a self-adjusting leverage producing that particular effect to the chair.

Mr. Baron Alderson.—Therefore a chair made on that principle which you have directed to be made would be an infringement of his patent.

Mr. Godson.—That being your lordship's opinion, I have nothing further to say on that point. I have now another ground to urge. Your lordship will remember that there was a man of the name of Lutton, who, the trade say, was the original inventor. The trial came on many months ago, and, by good luck, Lutton was then in the King's Bench, and, by *habeas corpus*, he was produced, but the cause not being heard on that day, Lutton has been absent from that time. We tried to obtain his presence at the trial. We called the witness who made those very iron plates for Lutton. We called a witness who saw the chair made on a self-adjusting principle. We called a witness who stuffed the chair for Minter to see; all was complete, except producing Lutton himself. I have an affidavit that, the moment the trial was over,

Lutton could walk forth, but as long as the trial was pending he was out of the way. We could not move to put off the trial on that ground. We could not say, we could produce him. I think the learned judge will see that we supplied every possible evidence that could be supplied, excepting Lutton, to shew that Lutton was the inventor.

Mr. Baron Alderson.—The case on the other side was, that Minter and Lutton were locked up together in a workshop on a Sunday, and the jury believed, and I thought so likewise, that they were inventing this patent.

Mr. Godson.—That was in consequence of our not being able to shew when Lutton left Wells Street, and the consequence was, that a witness said that somebody came there, and the inference was, that it was Minter.

Mr. Alderson.—No, not exactly somebody, "There was a man called Minter came to the house."

Mr. Godson.—But still we could not fix whether it was after the plates had been made and after the chairs had been stuffed for Minter. Whether Minter's being there on a Sunday was before or after the chair had been made.

Mr. Baron Alderson.—I will just read; that "a person of the name of Wilson, a baker, in Wells Street, said, Lutton occupied a back shop, four or five years, till June or September, 1831. I remember his shewing me a chair in 1830. Cannot say whether it was spring or autumn. He shewed it me in the back shop. It was a reclining chair, acting by balance: where the weight was, that part went down. I called upon him afterwards, in Dean Street. He went from Wells Street to Dean Street. He had several men in his employ. There was a man called Minter, who used to come on Sundays; and be with Lutton alone. I cannot recognise the plaintiff as being that Minter."

Mr. Godson.—Your lordship sees the great importance

of having Lutton. If those meetings were before the chair was shewn to Minter, what was the use of shewing him the chair? The parts you see were made by separate parties,—the wooden part by one party, the iron part by another, and it is stuffed by a third.

Mr. Baron Alderson.—Minter went to see how the combination did together.

Mr. Baron Gurney.—That is quite consistent.

Mr. Godson.—Minter was an uphosterer; what reason was there for Lutton to do this?

Mr. Baron Gurney.—Not to do it in his own shop.

Mr. Godson.—It was not done in Lutton's shop.

Mr. Baron Gurney.—No; it was done in different places in order that it might not be seen.

The rule was refused, thus supporting the validity of the patent.*

PROGRESS OF SCIENCE

APPLIED TO THE ARTS AND MANUFACTURES, TO COMMERCE, AND TO AGRICULTURE.

Negative Achromatic Lens.—In the preceding volume, p. 383, we gave a notice of the invention of this improvement in telescopes: the following is an abstract of another paper on the subject, read before the Royal Society on the 29th of May last, entitled "On the Principle of Construction and General Application of the Negative Achromatic Lens to Telescopes and Eye-pieces of every description. By Peter Barlow, Esq., F.R.S."

This paper is intended as a more full illustration of the principles on which the negative achromatic lens is constructed and applied, than has been given in the extract from the author's letter to Mr. Dollond, contained in the paper of the latter, lately read to the society, on his ingenious application of that lens to the micrometer eye-piece. The author shows that its advantages are not confined to this instrument, but that it is applicable to any eye-piece positive or negative to the

* We are informed that there are at least twenty actions against other infringements, but this decision has induced the defendants to come to the patentee's terms.—Ed.

erecting eye-piece, and, indeed, to any telescope of fluid or glass, and also to refractors.—*Proceedings of the Royal Society.*

On Naval Architecture. By Jeremiah Owen.—A great deal has been done by mathematicians towards attempting to establish a general theory of resistances, and considerable expense has been incurred in conducting experiments, some of which have been made on the Continent under the superintendence of eminently scientific men. D'Alembert, Bossut, Romme, and several others were employed at different times in experiments of this nature. Don Juan in Spain, and Chapman, the great Swedish naval architect, also made several experiments on the same subject; as did also the Society for the Improvement of Naval Architecture, which was established in England some years ago, but which has now ceased to exist.

These experiments have always been made upon models, the largest of which, it is believed, have never exceeded 14 feet in length. They were generally much smaller. The results which have been thus obtained on small bodies have not been found to agree with results similarly obtained on larger bodies, and not only has this been the case, but experiments conducted apparently with equal care by different individuals have even led to different results.

Naval architecture has, consequently, gained but little from the labour that has been bestowed upon these experiments, and the forms which have been given by different individuals to ships have depended rather upon the fancy and general experience of those individuals than upon any facts which this branch of experimental science has furnished.

In order to discover that form of the body of a ship which shall oppose the least resistance to its passage through the water, the author recommends that experiments be made on ships themselves, under all the ordinary circumstances of sailing.

These experiments must be conducted not in the mode in which experimental squadrons have hitherto been, viz. by comparing together the sailing qualities of ships that have varied in every particular. We are no more justified in saying that results obtained in this way have proved which form of body is best calculated for velocity, than we are in saying which ship has been the best managed.

If it be desirable to discover by experiment which of two or more forms is best adapted for velocity, it is, of course, necessary that the form shall be the only variable element; the ships in *every other* respect must be exactly similar.

By the aid which the mathematics afford, we shall be able most completely to accomplish this. Let a ship be given which sails well, and which is in all other respects an efficient man-of-war as regards

capacity, stability, &c. &c. Let this ship be docked, and let the most complete drawings of her form be made, from which we shall be able to calculate exactly every necessary element, such as displacement, area of midship section, of loadwater section, stability, &c., and let the surface of sail, the position and rake of masts be also ascertained.

Then let one or more ships be constructed, having exactly the same principal elements as the given one, with whatever difference of form it may be thought proper to select, and let the same surface of sail be given to them all. We shall thus have the same weights to be moved, and the same propelling force to move them; the result will, of course, show which form is best calculated for velocity.

These ships may be made to sail against each other under every possible circumstance of sailing, taking care always to apply the propelling force in the same way, that is, by bracing the corresponding yards of all the ships to the same angle with a fore and aft line, during every comparison, and by raking the masts to the same degree.

It is of importance that during the experiments the surface of sail in each ship should be presented, as nearly as possible, at the same angle to the action of the wind, and this is perfectly practicable, for it is easy to measure the angles of the yards by an instrument for that purpose; and the officer who commands the squadron can take care, by means of frequent signals, to have the yards of all the ships braced to the same angle at the same time.

These experiments would not be limited in their result to the discovery merely of that form of a ship which is best calculated for velocity, although this of itself is so important as to justify almost any expense, but we might also be able to discover how far the angle of leeway is affected by the form, which is also a very important question connected with the sailing of ships; and after having, by repeated and careful trials, discovered the order of superiority of ships in respect of velocity, we might then, by varying the angle of bracing the yards, discover also the trim of the sails and the course of the ship by which to gain most on a wind, a question which is not by any means satisfactorily settled, in as much as it involves all the uncertainty of our present knowledge of the resistance of fluid.

Experiments to determine this latter question might, however, be made immediately on sister ships, of which there are several at present in His Majesty's service.

Let two ships be selected of the same form, and let the utmost pains be taken to make the position and rake of the masts, the seat in the water, the stowage of the ballast, and of all the heavy weights, exactly the same in both ships, and let them be compared together in sailing both on the wind and at various points off the wind; the angles

of bracing the yards being constantly varied, we should doubtless, from a series of experiments of this nature, succeed in discovering the best trim of the sails of every direction of the wind on every course.

It may, perhaps, be urged against a series of experiments like those which have been here recommended, that the expense of building a ship is so great as to render it advisable not to run the risk of building a bad one for the sake of experiment merely. But the author suggests that our knowledge of naval architecture is such as to enable us to construct ships which we can certainly predict will be good, notwithstanding they may not be the best that might be produced; and the ships which would be included in the experiments proposed would have all the essential qualities of a man-of-war, except that by differing in form, some would be superior to others in respect of velocity.

Naval architecture is a branch of science which depends so essentially upon experiment for its advancement, and the experiments are necessarily upon so large and expensive a scale, as to place it out of the power of individuals, or even of societies of individuals, to conduct them. It is, therefore, one of those enterprises in science which none but a nation can undertake; and it is worthy of so great a maritime nation as England to endeavour to advance, at whatever reasonable cost, a subject so important in its defence.—*Report of the Third Meeting of the British Association for the Advancement of Science.*

On a Steam-engine for pumping Water. By W. L. Wharton.—In this engine the steam is admitted from the boiler upon a deep float, occupying the top of a column of water contained in a metallic cylinder, placed in the flue of the boiler fire. The lower part of the column of water is connected by pipes to the under side of a piston, moving water-tight in a much smaller cylinder, fixed immediately above the pumps of any mine, to the rods of which is affixed the piston rod. By this arrangement the steam always acts upon a heated surface, and its power is applied to the pump rods without the intervention of a main beam, parallel motion, &c., and, consequently, without any expense for frame-work and buildings requisite for their support in other engines. The friction of this engine, moreover, is very trifling, a stratum of oil being introduced both above and below the piston. A rod on wire is attached to the float, and, passing through a stuffing box in the top of the large cylinder, works the hand gear at the proper periods after the admission and escape of the steam, and consequent depression and elevation of the water and float, within that cylinder. A condensing apparatus may be added, by which the atmosphere may be rendered available, in addition to the weight of the pump rods, to force down the piston in the small cylinder, and, consequently, the water and

float to the top of the large cylinder, after each stroke of the engine. —*Report of the Third Meeting of the British Association for the Advancement of Science.*

LAWS OF MOTION OF STEAM-VESSELS.—The following is the official abstract of a paper read before the Royal Society, on the 29th of May last, entitled "An Investigation of the Laws which Govern the Motion of Steam-Vessels, deduced from experiment. By P. W. Barlow, Esq., Civil Engineer."

The author commences with the description of a paddle-wheel for steam-vessels, of a new construction, in which the floats are made to enter and leave the water nearly in a vertical position. He then investigates several formulæ adapted to the calculation of the forces and velocities arising from this form of the apparatus; and gives an account of the results of various experiments made on its efficiency as compared with the common wheels, and with relation to the consumption of fuel. The general results to which he is led are as follows: 1st. When vessels are so laden as that the wheel is but slightly immersed, little advantage is derived from the vertically acting paddles. 2ndly. In cases of deep immersion, the latter has considerable advantage over the wheel of the usual construction. 3rdly. In the common wheel, while the paddle passes through the lower portion of the arc, that is, when its position is vertical, it not only affords less resistance to the engine, but is less effective in propelling the vessel than in any part of its revolution. 4thly. The paddle of the wheel, while passing through the lower portion of the arc, affords more resistance to the engine, and is more effective in propelling the vessel, than in any part of its revolution; a property which is a serious deduction from its value; for, in consequence of the total resistance to all the paddles being so much less than in the common wheel, much greater velocity is required to obtain the requisite pressure, and a greater expenditure of steam power is incurred. This loss of power is most sensible when the wheel is slightly immersed; but in cases of deep immersion the vertical paddle has greatly the advantage. 5thly. In any wheel, the larger the paddles the less is the loss of force; because the velocity of the wheel is not required to exceed that of the vessel in so great a degree, in order to acquire the resistance necessary to propel the vessel. 6thly. With the same boat and the same wheel no advantage is gained by reducing the paddle so as to bring out the full power of the engine; the effect produced being simply that of increasing the speed of the wheel, and not that of the vessel. 7thly. An increase of speed will be obtained by reducing the diameter of the wheel; at least within such limits as allow of the floats remaining sufficiently immersed in the water; and provided the velocity of the engine does not exceed that at which it can perform its work

properly. 8thly. An advantage would be gained by giving to the wheel a larger diameter, as far as the immersion of the paddles produced by loading the vessel would not so sensibly affect the angle of inclination of the paddle; but this advantage cannot be obtained with an engine of the same length of stroke, because in order to allow the engine to make its full number of strokes, it well then be necessary to diminsh the size of the paddles, which is a much greater evil than having a wheel of smaller diameter with larger paddles.—*Proceedings of the Royal Society.*

On the Thermostat, or Heat-governor, a self-acting physical Apparatus for regulating Temperature, By Andrew Ure, M.D., F.R.S., &c.—This instrument acts by the unequal expansion of different metals in combination: it admits of many modifications of external form, but in all, the metallic bars must possess such force of flexure in heating or cooling as to enable their working rods or levers to open or shut valves, stopcocks, and ventilating orifices.

Steel and zinc are the two metals employed: they possess a great difference of expansiveness, nearly as two to five, and are sufficiently cheap to enter into the composition of thermostatic apparatus; but zinc has in reference to the present object one property which should be corrected. After being many times heated and cooled, a rod of that metal remains permanently elongated. This property may, however, be in a great measure destroyed, and considerable rigidity acquired by allying it with four or five per cent. of copper and one of tin. Such an alloy is hard, close-grained, elastic, and very expansible, and therefore suits pretty well for making the more expansible bar of a thermostat.

Let a bar of zinc or of this alloy be cast, about an inch in breadth, one quarter of an inch thick, and 2 feet long, and let it be firmly and closely rivcted along its face to the face of a similar bar of steel of about one third the thickness. The product of the rigidity and strength of each bar should be nearly the same, so that the texture of each may pretty equally resist the strains of flexure. Having provided a dozen such compound bars, let them be united in pairs by a hinge-joint at each of their ends, having the steel bars inwards. At ordinary temperatures the steel plates of such a pair of compound bars will be parallel and nearly in contact, but when heated they will bend outwards, receding from each other at their middle parts, like two bows tied together at their ends. Supposing this recession to be one inch for 180° Fahrenheit, then 6 such pairs of bows, connected together in an open frame with rabbeted end plates, and with a guide rod playing through a hole in the centre of each, will produce an effective aggregate motion of six inches, being half an inch for every

15° Fahr., or $8\frac{1}{3}$° C. Instead of limiting ourselves to half a dozen such pairs of compound bars, we may readily lodge in a slender iron frame a score or two of them, so as to furnish as great a range of motion as can be desired for most purposes of heat regulation; and the power of pressure or impulsion may be increased, if necessary, by increasing somewhat the thickness of each component lamina. One extremity of the series must obviously be firmly abutted against a solid fulcrum or bearing, while the opposite extremity gives motion to a working rod of a suitable kind.

The author of the communication then describes in detail the various mechanical adjustments by which the apparatus may be applied to maintain any determined rate of ventilation through the casements of church windows; to give alarm and open valves in water-cisterns in case of fire; to preserve a certain rate of combustion in furnaces, a uniform temperature in baths and stills, and to act as a safety-valve for a steam-engine.—*Report of the Third Meeting of the British Association for the Advancement of Science.*

On Chinese Vermilion.—[Translated into French from a Chinese Technologic Encyclopædia, entitled, *Thian-koung Kaï-we, or Exposition of the Wonders of Nature and the Arts.* By M. Stanislas Julien.*] From the *Nouveau Journal Asiatique.*

Cinnabar, liquid silver, the red of silver, are, in reality, one and the same thing. What causes them to bear different names, is, that the substance is either pure or coarse, or old or recently extracted.

Cinnabar, of the first quality, comes from *Chinpé* (now *Mayang*), and from *Sitchouan.* It is found in a state of purity in the bosom of the earth, and does not require purification by fire. This cinnabar, which is used to polish the tips of arrows, metallic mirrors, &c., is thrice as valuable as mercury: whence it is carefully picked and sold under its native form, that is, in the state of sand or red powder. If melted it loses a great part of its value.

The course cinnabar, of the second quality, needs to be purified by the fire, when it forms mercury.

The cinnabar of the first quality is found by digging the ground at a depth of 70 feet. The presence of the mineral is indicated by the appearance of small white granular stones. The largest pieces are of the size of an egg. The second sort does not enter into any pharmaceutic preparation. It is ground up and used by the painters and colourists in the same manner as that which is prepared directly from mercury. Its matrix does not always appear under the form of white stones, but has sometimes a mixture of blue and yellow. It is found about 20 feet below the other. Sometimes it is met with in a stratified

* The Chinese edition whence this article is extracted bears the date of 1637.

sandy soil, and then the stony and sandy gangue is easily separated. This kind of cinnabar is found in abundance at *Koucitchou Ssein*, at *Thoungjin*, &c., also in great quantities at *Changtcheou* and at *Tsintcheou*.

The cavities from which the second sort is collected, have a whitish aspect. When recently extracted, it may be separated without the necessity of previous founding. This cinnabar, on first coming from the mine, has a brilliant surface, which soon tarnishes on contact with the air.

To prepare the vermilion, they take the cinnabar, and pound it in an iron mortar shaped like a boat, with a stone pestle of a flattened spherical form, and placed at the end of a vertical lever moved by four men, by means of a bar which passes through it. The powder is thrown into clear water, and left to soak for three days and three nights. One part falls to the bottom of the vessel, the other, lighter, floats on the surface: this is removed with a skimming ladle, and placed in a second vessel. It is then called *Eult chou*, or *second red*. The cinnabar which was deposited in the first vessel, is taken out, dried in the sun, and is then called *Theout chou*, or *first red*.

To obtain quicksilver from the ores, either the second quality, inferior cinnabar, white and newly extracted, or the deposit or the skum separated on the surface of the water, are employed. Thirty pounds of one of the above ores is put into an iron vessel, with a convex head of the same metal, having a small opening in its centre, the two are carefully luted together, and a curved iron tube fitted hermetically into the aperture at the top, with hemp and luting.

Thirty pounds of charcoal are necessary for the distillation: when the retort becomes hot, one end of the iron tube is plunged into cold water, so that the vapour which rises from the metal pot distils over through the tube, and condenses in the water. In five hours the whole of the cinnabar is transformed into mercury, which is taken out of the water after having been suffered to repose for 24 hours.

Sometimes the mercury is treated afresh, to be converted into vermilion, which is then called *Intchou*, that is to say, *red of quicksilver*. A retort of porcelain, or a double vessel of metal, are employed indifferently for this purpose: to one pound of mercury, two pounds of sulphur are added; the mixture is triturated until it forms a blackish powder: it is then put into the crucible, which is covered with an iron cover, held down by a bar of iron laid across the top of it, and tied down on either side to the lower vessel, by means of a loop of brass wire made fast round the latter. All the openings are then carefully closed with lute, and the pot is set upon an iron tripod, under which a fire of resinous faggots is maintained for a considerable time; whilst

the cover is kept cool with an old swab soaked in water. The mercury then combines with the sulphur, and sublimes in a very fine powder, which adheres to the sides of the vessel. The cinnabar which fixes on the inside of the cover is of the brightest colour. When the vessel is quite cold, the vermilion is taken out. The excess of sulphur is found precipitated to the bottom, and may be employed a second time. One pound of mercury gives fourteen ounces of cinnabar of the first quality, and three ounces and a half of the second quality.

The cinnabar obtained by the action of fire, and that from the pulverized native ore, have exactly the same appearance; nevertheless, the former is never used in painting the houses of princes and persons of distinction: the only sort employed for this purpose being the pure pulverized mineral from *Thoung chin* and *Pe-tchouan.*

When intended to be used in writing, the vermilion is ground up with gum, and made into small cakes. Rubbed upon a stone pallet (encrier), it presents a red of the richest brilliancy: if pounded on a tin slab, it forms a black colour, and is then fit for the varnishers, and gives to objects a glistening tint which enhances their price. Mixed with the oil of the *Thoung tree,* it assumes a very bright appearance: but if varnish be added to this, it loses its brilliancy and becomes of a deep black colour.

Thus we have described faithfully all that concerns the preparation of native and artificial cinnabar, as well as that of mercury. All that has been said about *the sea of cinnabar,* and *the vegetable cinnabar,* rests on no foundation whatever: they are mere reveries fit to amuse the credulous and lovers of the marvellous.

When mercury has been converted into vermilion, it has no longer the power to return to its original state, because it has then arrived at what may be called *the final limit of transformation.*

Journal of the Asiatic Society of Bengal, for April, 1832.

ANALYSIS OF THE MOIRA BRINE SPRING NEAR ASHBY-DE-LA-ZOUCH, LEICESTERSHIRE, WITH RESEARCHES ON THE EXTRACTION OF BROMINE. BY ANDREW URE, M.D., F.R.S.—The water derived from the spring in question is raised by means of a pump from the coal-mines in the neighbourhood of Ashby-de-la-Zouch*, is much used as medicinal baths, and is also administered internally, principally as a remedy for bronchocele and scrofulous tumors. The result of the analysis made by the author, is that it contains per gallon,

* The occurrence of this strong brine spring in the coal measures illustrates part of Mr. Brayley junr.'s outline of the geological history of common salt, given in the preceeding volume, *p.* 265.—A. T.

	grs.
Bromide of sodium and magnesium	8·
Chloride of calcium	851·2
———— magnesium......	16·
———— sodium....................	3700·5
Protoxide of iron, a trace	
Solid contents.........................	4575·7

After removing from the water the deliquescent chlorides of lime and magnesia by the addition of carbonate of soda, he transmits through the mother liquor, consisting of chloride and bromide of sodium, a current of chlorine gas, till it communicates the maximum golden tint, and then adds sulphuric æther, which, by agitation, carries with it to the surface the bromine and chlorine, constituting a reddish yellow stratum. The proportion in which these two elements exist in the evaporated solution may be ascertained with the greatest nicety by the addition of a solution of nitrate of silver; the method of calculation for this purpose being detailed by the author.—*Proceedings of the Royal Society, June 19th,* 1834.

RAVAGES IN TIMBER OF THE TEREDO NAVALIS AND THE LIMNORIA TEREBRANS.—On the 19th of June last, a paper, of which the following is an abstract, was read before the Royal Society entitled "Observations on the *Teredo navalis* and *Limnoria terebrans* as at present existing in certain localities of the British Islands. By William Thompson, Esq., Vice-President of the Natural History Society of Belfast."

The opinion which has been advanced, that the *Teredo navalis* is no longer to be found on the British coast, is shewn by the author to be erroneous; for numerous specimens of that destructive animal, collected from the piles used in the formation of the pier at Portpatrick in Ayrshire, were furnished to him by Captain Frayer, R.N. (of His Majesty's steam-packet Spitfire). Some of these specimens had attained the length of nearly two feet and a half, a magnitude at least equal to, if not exceeding, the largest brought from the Indian seas. After giving a description of the animal, the author enters into an inquiry into the agency it employs to perforate the timber which it consumes as food, and in which it establishes its habitation. He ascribes to the action of a solvent, applied by the proboscis, the smooth and rounded termination of its cell, which is afterwards enlarged by the mechanical action of the primary valves.

The author then gives an account of the natural history and operations of another animal, the *Limnoria terebrans*, of Leach, belonging to the class of Crustacea, whose depredations on timber are no less extensive and formidable than the *Teredo*. At Portpatrick it appears

that both these animals have combined their forces in the work of destruction, the *Teredo* consuming the interior, and the *Limnoria* the superficial parts of the wood; the latter continuing its labours until it comes in contact with the shells of the former, so that the whole mass is speedily deprived of cohesion. It is stated, on the authorities of Mr. Hyndman and Mr. Stephen, that the *Limnoria* is already committing great ravages in the timber at Donaghadee.—*Proceedings of the Royal Society.*

On the Native Method of Making the Paper, Denominated in Hindustán, Nipalese. By B. H. Hodgson, Esq. Acting Resident, Nepal.—For the manufacture of the Nipalese paper, the following implements are necessary, but a very rude construction of them suffices for the end in view.

1st. A stone mortar, of shallow and wide cavity, or a large block of stone, slightly but smoothly excavated.

2nd. A mallet or pestle of hard wood, such as oak, and in size proportioned to the mortar, and to the quantity of boiled rind of the paper plant which it is desired to pound into pulp.

3rd. A basket of close wicker work, to put the ashes in, and through which water will pass only drop by drop.

4th. An earthen vessel or receiver, to receive the juice of the ashes after they have been watered.

5th. A metallic open-mouthed pot, to boil the rind of the plant in. It may be of iron, or copper, or brass, indifferently; an earthen one would hardly bear the requisite degree of fire.

6th. A sieve, the reticulation of the bottom of which is wide and open, so as to let all the pulp pass through it, save only the lumpy parts of it.

7th. A frame, with stout wooden sides, so that it will float well in water, and with a bottom of cloth, only so porous that the meshes of it will stay all the pulp, even when dilated and diffused in water; but will let the water pass off, when the frame is raised out of the cistern; the operator must also have the command of a cistern of clear water, plenty of fire-wood, ashes of oak, (though I fancy other ashes might answer as well,) a fire place, however rude, and, lastly, quantum sufficit of slips of the inner bark of the paper tree, such as is peeled off the plant by the paper-makers, who commonly use the peelings when *fresh* from the plant; but that is not indispensable. With these "appliances and means to boot," suppose you take four seers of ashes of oak, put them into the basket above mentioned, place the earthen receiver or vessel beneath the basket, and then gradually pour five seers of clear water upon the ashes, and let the water drip slowly through the ashes and fall into the receiver. This juice of ashes must be strong, of a dark bark-like red colour, and in quantity about 2lbs.;

and if the first filtering yield not such a produce, pass the juice through the ashes a second time. Next, pour this extract of ashes into the metal pot already described, and boil the extract, and so soon as it begins to boil, throw into it as many slips or peelings of the inner bark of the paper plant as you can easily grasp, each slip being about a cubit long, and an inch wide; (in fact the quantity of the slips of bark should be to the quantity of juice of ashes, such that the former shall float freely in the latter, and that the juice shall not be absorbed and evaporated with less than half an hour's boiling.) Boil the slips for about half an hour, at the expiration of which time, the juice will be nearly absorbed, and the slips quite soft. Then take the softened slips, and put them into the stone mortar, and beat them with the oaken mallet, till they are reduced to a homogeneous or uniform pulp, like so much dough. Take this pulp, put it into any wide-mouthed vessel, add a little pure water to it, and churn it with a wooden instrument like a chocolate mill, for 10 minutes, or until it loses all stringiness, and will spread itself out when shaken about under water.

Next, take as much of this prepared pulp as will cover your paper frame (with a thicker or thinner coat, according to the strength of the paper you need), toss it into such a sieve as I have described, and lay the sieve upon the paper-frame, and let both sieve and frame float in the cistern: agitate them, and the pulp will spread itself over the sieve; the grosser and knotty parts of the pulp will remain in the sieve, but all the rest of it will ooze through into the frame. Then put away the sieve, and taking the frame in your left hand, as it floats on the water, shake the water and pulp smartly with your right hand, and the pulp will readily diffuse itself in an uniform manner over the bottom of the frame. When it is thus properly diffused, raise the frame out of the water, easing off the water in such a manner, that the uniformity of the pulp spread shall continue after the frame is clear of the water, *and the paper is made.*

To dry it, the frame is set endwise, near a large fire; and so soon as it is dry, the sheet is peeled off the bottom of the frame, and folded up. When (which is seldom the case) it is deemed needful to smooth and polish the surface of the paper, the dry sheets are laid on wooden boards, and rubbed with the convex entire side of the conch-shell; or, in case of the sheets of paper being large, with the flat surface of a large rubber of hard smooth-grained wood; no sort of size is ever needed or applied to prevent the ink from running. It would probably surprise the paper-makers of England, to hear that the *Kachár* Bhoteahs can make up this paper into fine smooth sheets of *several yards square.* This paper may be purchased at Katmandú in almost any quantity, at the price of 17 annas sicca per *dharni* of

three seers: and the bricks of dried pulp may be had * at the same place, for from eight to ten annas sicca per *dharni*. Though called Nipalese, the paper is not, in fact, made in Nepal Proper. It is manufactured exclusively in Cis-Himalayan Bhote, and by the race of Bhoteahs denominated (in their own tongue) *Rangbo*, in contradistinction to the Trans-Himalayan Bhoteahs, whose vernacular name is *Sokhpo*.† The *Rangbo* or Cis-Himalayan Bhoteahs are divided into several tribes (such as *Múrmi*, *Lapcha*, &c. &c.), who do not generally intermarry, and who speak dialects of the Bhote or Tibet language so diverse, that, ignorant as they are, several of them cannot effectually communicate together. They are all somewhat ruder, darker, and smaller, than the Sokhpos, or Trans-Himalayan Bhoteahs, by whom they are all alike held in slight esteem, though most evidently *essentially* one and the same with themselves in race, and the language, as well as in religion.

To return to our paper making—most of the Cis-Himalayan Bhoteahs east of the Kali River, make the Nipalese paper; but the greatest part of it is manufactured in the tract above Nepal Proper, and the best market for it is afforded by the Nipalese people, and hence probably it derived its name; a great quantity is annually made and exported southwards to Nepal and Hindústan, and, northwards, to *Sakya-Gúmba*, *Digarchí*, and other places in Tramontane Bhote. The manufactories are mere sheds, established in the midst of the immense forest of Cis-Himalayan Bhote, which affords to the paper-makers an inexhaustible supply, on the very spot, of the firewood and ashes, which they consume so largely. Abundance of clear water (another requisite) is likewise procurable everywhere in the same region. I cannot learn by whom or when the valuable properties of the paper plant were discovered; but the Nipalese say, that any of their books now existent, which is made of Palmira leaves, may be safely pronounced, on that account, to be 500 years old: whence we may perhaps infer that the paper manufacture was founded about that time. I conjecture, that the art of paper-making was got by the Cis-Himalayan Bhoteahs, viâ Lhassa, from China—a paper of the very same sort being manufactured at Lhassa; and most of the useful arts of these

* The pulp is dried and made up into the shape of bricks or tiles, for the convenience of transport. In this form, it is admirably adapted for transmission to England. See the P.S.

† The Newar language has terms precisely equivalent to these; the Rangbo being called, in Newary, Paloo Sén; and the Sokhpo, Thá Sén. The Sokhpo here spoken of is not really a different word from Soghpúr-nomade, the name *ordinarily* applied in Bhote to the Mongols. But this word has at least a different sense in the mouths of the Tibetans towards *this* frontier, on both sides of the snows.

regions having flowed upon them, through Tibet, from China; and not from Hindústan.

Nepal Residency, Nov., 1831.

P.S. Dr. Wallich having fully described the paper *plant,* it would be superfluous to say a word about it. The raw produce or pulp (beat up into bricks) has been sent to England, and declared by the ablest persons to be of unrivalled excellence, as a material for the manufacture of that sort of paper upon which proof-engravings are taken off. The *manufactured* produce of *Nepal* is for office records incomparably better than any Indian paper, being as strong and durable as leather almost, and quite smooth enough to write on. It has been adopted in one or two offices in the plains, and ought to be generally substituted for the flimsy friable material to which we commit all our records.—*Journ. of the Asiat. Soc. of Bengal, Jan.* 1832.

ACCOUNT OF THE DEPTHS OF MINES. BY JOHN TAYLOR, F.R.S.—Mr. Taylor exhibited a section, showing the depths of shafts of the deepest mines in the world, and their position in relation to the level of the sea.

The absolute depths of the principal ones were:

	Feet.
1. The shaft called Roehrobichel, at the Kitspühl mine in the Tyrol	2764
2. At the Sampson mine, at Andreasberg in the Harz	2230
3. At the Valenciana mine, at Guanaxuato, Mexico	1770
4. Pearce's shaft, at the Consolidated mines, Cornwall	1464
5. At Wheal Abraham mine, Cornwall	1452
6. At Dolcoath mine, Cornwall	1410
7. At Ecton mine, Staffordshire	1380
8. Woolf's shaft, at the Consolidated mines	1350

These mines are, however, very differently situated with regard to their distance from the centre of the earth as the last on the list, Wolf's shaft, at the consolidated mines, has 1230 feet of its depth below the surface of the sea, while the bottom of the shaft of Valenciana in Mexico is near 6000 feet in absolute height above the tops of the shafts in Cornwall. The bottom of the shaft at the Sampson mine in the Harz is but a few fathoms under the level of the ocean; and this and the deep mine of Ritspühl form, therefore, intermediate links between those of Mexico and Cornwall.

Mr. Taylor stated, that taking the diameter of the earth at 8000 miles, and the greatest depth under the surface of the sea being 1230 feet, or about $\frac{1}{4}$th of a mile, it follows that we have only penetrated to the extent of $\frac{1}{32000}$ part of the earth's diameter.

Some account was then given of the mines to which the shaft referred to belong.

Of the deepest, at Kitspühl, as it has long ceased to work, we do

not know much. Villefosse, in his great work on the *Richesse Minérale de l' Europe*, states that this was a copper mine, which passed for being the deepest in Europe; and that in 1759, it was reported on, amongst other mines, by M.M. Jars, and Duhamel, and it was then proposed to abandon the working, the water having been already suffered to rise near 200 fathoms.

The Sampson mine in the Harz is one of the most celebrated in that district: it has been working since the middle of the 16th century, and produces silver ores of superior quality. The principal shaft is sunk about 6 feet deeper every year, by which ground enough is drained for a regular extraction of the ores. The mine is one of the oldest in Germany, and has always been profitable: it employs from 400 to 500 men. It is the property of shareholders, who are very numerous, the interest having been much subdivided in the course of time.

The mine of Valenciana at Guanaxuato was one of the most renowned in Mexico. It produced annually about the end of the last century, 360,000 ounces of silver, worth 600,000 sterling, and then employed 3100 persons. The shaft referred to in the section was commenced in 1791, the mine having been long previously worked by other shafts: it had attained its present depth in 1809 when the mine was stopped by the revolution. It is octagonal, and more than 30 feet in diameter, a great part of its depth being walled with beautiful masonary, and is probably the most magnificent work of the kind. The expense of forming this shaft is estimated by Humboldt at the enormous sum of 220,000*l.* The mine was so little troubled with water that it was considered almost a dry one; during the suspension of the works, it, however, gradually filled. In 1825 one of the English companies undertook to drain it, which was, after great labour and expense, accomplished; but the mine has not been sufficiently productive since to make it worth while to continue the working.

The consolidated mine forms the most extensive concern in Cornwall, embracing what were formerly several distinct mines, which, as the name indicates, were connected in one undertaking.

This was arranged in 1818, and the mines which had remained unwrought for many years were drained by very powerful steam-engines, and were put into a state of active working. The management was confided to Mr. Taylor and the late Captain William Davey: an outlay of 73,000*l.* was incurred, which has since been repaid with ample profit. The present produce is 20,000 tons of ore a year, yielding about 1920 tons of fine copper, being $\frac{1}{7}$th of the whole quantity raised in Great Britain. The mines employ about 2400 persons of whom about 1400 are miners working underground. The water

raised to the adit level is about 2000 gallons per minute: the height to which this is lifted is more than 220 fathoms, or 1320 feet; the aggregate weight of the columns of water in the pumps being 512,000 pounds, or about 230 tons, and the whole is put in motion by 8 immense steam-engines, four of which are the largest ever made.

The depth of the mines has been increased 100 fathoms since the period of the drainage being completed, being at the rate of about eight fathoms a year.

There are, in the whole concern, 95 shafts, besides other perpendicular communications from level to level underground, called winzes. The depths of the whole added together make up about 22,000 fathoms, or 25 miles; and the levels, or galleries, will make up, in horizontal distance, a length of 38,000 fathoms, or about 43 miles.

Wheal Abraham is an old copper mine, the working of which was abandoned a few years since, the vein having ceased to be productive in depth. It was, until very lately, the deepest mine from the surface in Cornwall, but is now surpassed by the consolidated mines.

Dolcoath mine was formerly called Bullen Garden, and a section of it, as it was at that time, will be found in Dr. Pryce's work, *Mineralogia Cornubiensis*, published in 1778. It was then rather more than 90 fathoms deep, and, probably, one of the deepest mines at that time. It has, therefore, been sunk 140 fathoms since; but, like all the great mines, it has not been in constant work. It has now been actively prosecuted for many years, and, at present, stands third in the list of copper mines in Cornwall, arranging them according to the value of their produce. That of Dolcoath, however, does not amount to one half of that of the Consolidated mines.

Ecton mine is celebrated in most books on mineralogy as one of the principal copper mines in England; and it was so at one period, though the produce is now inconsiderable. It is situated in Staffordshire, on the borders of Derbyshire, and is very curious, from being in limestone and having no regular vein. The ore has been found in large masses, irregularly deposited, and is generally taken to be an example of contemporaneous formation. The mine has been regularly worked for a long series of years, and is now nearly exhausted. It is the property of the Duke of Devonshire, and very large profits were given by it in the latter part of the last century, some of which, it is said, were applied by the late Duke to the erection of the beautiful Crescent at Buxton. The mine is not far distant from this place, and is in a very picturesque situation on the banks of the Manifold.

Mr. Taylor gave some account of the extent to which steam power is at present employed in Cornwall in draining the mines which penetrate so far beneath the level of the sea, showing the influence

that the great improvements, which have from time to time been made, and many of them even recently, must have upon the production of some of the most useful metals.

The number of steam-engines used in pumping water from the mines in Cornwall in December, 1832, was altogether 64.

Some of these are of immense size and power: there are 5 in the the county, of which the diameter of the cylinder is 90 inches the pistons making a stroke of 10 feet. Four of these are at the Consolidated mines, and the first constructed of this size was planned and erected there by Mr. Woolf. The beam of such an engine weighs 27 tons; the pump-rods are of mast timber, 16 inches square, connected by iron strapping-plates of enormous weight. The column of water lifted, the rods and beam, make up a weight of more than 100 tons, and this is kept in motion at the rate of from five to ten strokes per minute.

The quantity of coal consumed in drawing water in the same month in all the mines of Cornwall was 84,034 bushels, and the quantity of water delivered, about 19,279 gallons per minute. The weight of water actually poised by all these engines to produce this effect amounts to about 1137 tons.

From calculations carefully made in Mexico as to horse power employed in draining mines, and deduced from a large scale of operations, it is found that the performance is equal to 19,000 lbs. raised one foot high per minute for each horse.

According to this rate, the coal consumed in Cornwall in a month being 84,000 bushels, or 2800 per day, and taking the duty of the engines at 55,000,000 lbs. lifted one foot by each bushel, which is very nearly the fact, it will be found that the 16th part of a bushel does as much in raising water in Cornwall as a horse does in Mexico (working three hours out of 24), and that thus the number of horses required to drain the mines of Cornwall would be 44,800.—*Report of the Third Meeting of the British Association for the Advancement of Science.*

A. T.

NOTICE OF EXPIRED PATENTS,

(*Continued from p.* 320.)

James Harcourt, of Birmingham, Warwickshire, Brassfounder, for an improvement in castors applicable to tables and other articles. —Sealed June 21, 1820.—(*For copy of specification, see Repertory, Vol.* 43, *second series, p.* 325.)

John Read, of Horsmanden, Kent, Gentleman, for an improvement on syringes.—Sealed July 11, 1820.

James White, of Manchester, Lancashire, Civil Engineer, for certain new machinery, adapted to preparing and spinning wool, cotton, and other fibrous substances, and uniting several threads into one, and also certain combinations of the said new machinery with other machines, or with various parts only of other machines already known and in use.—Sealed July 11, 1820.

Samuel Fletcher, of Walsal, Staffordshire, Sadlers'-Ironmonger, for an improvement on, or additions to, saddles, saddle-straps, saddle-girts, and saddle-cloths, by the application of certain known materials hitherto unused for that purpose.—Sealed July 11, 1820.—*(For copy of specification, see Repertory, Vol.* 43, *second series, p.* 327.)

William Davis, late of Brimscomb, but now of Bourne, near Minchin Hampton, Gloucestershire, Engineer, for certain improvements in machinery for shearing or cropping woollen and other cloths requiring such process.—Sealed July 11, 1820.—*(For copy of specification, see Repertory, Vol.* 39, *second series, p.* 129.)

John Grafton, of Edinburgh, Civil Engineer, for a new and improved method or methods of distilling the products of coal, and carbonising coal, in the processs of making gas used for the purpose of illumination.—Sealed July 11, 1820.—*(For copy of specification, see Repertory, Vol.* 44, *second series, p.* 324.)

Matthew Bush, of Battersea Fields, Surrey, Calico Printer, for an improvement on a machine, now in use, for printing silks, linens, calicoes, woollens, and other similar fabrics, by means of which improvement shawls and handkerchiefs can be printed with one or more colour or colours, and whereby linens, calicoes, silks, woollens, and other fabrics of the like nature, intended for garments, can be printed with two or more colours.—Sealed July 20, 1820.

Robert Bowman, of Manchester, Lancashire, for improvements in the construction of looms for weaving various sorts of cloths, which looms may be set in motion by any adequate power.—Sealed July 20, 1820.

Job Rider, of Belfast Foundry, Ireland, Ironmonger, for certain improvements which produce a concentric and revolving eccentric motion, applicable to steam-engines, water-pumps, mills and other machinery.—Sealed July 20, 1820.

William Dell, of Southampton, Auctioneer, for an improvement in gun-barrels.—Sealed July 20, 1820.

Henry Botfield Thomason, son of Edward Thomason, of Birmingham, Warwickshire, Manufacturer, for certain improvements in the making and manufacturing of cutlery, viz., that class of cutlery

called or styled table-knives, dessert-knives, fruit-knives, pocket-knives, scissors, razors, and surgical instruments.—Sealed July 20, 1820.

John Hudswell, of Addle Street, London, Wafer Manufacturer, for an improvement in the manufacture of wafers.—Sealed July 20, 1820.

James Harvie, late of Berbice, now in Glasgow, Engineer, for improvements in the construction of machines commonly called ginning machines, and which are employed in separating cotton-wool from the seeds. Communicated to him by certain persons residing abroad.—Sealed August 18, 1820.—(*For copy of specification, see Repertory, Vol.* 45, *second series, p.* 14.)

George Millichap, of Worcester, Coachmaker, for an improvement on axletrees and boxes.—Sealed August 18, 1820.—(*For copy of specification, see Repertory, Vol.* 40, *second series, p.* 129.)

Robert Frith, of Salford, Lancashire, Dyer, for improvements in the method of dying, and printing various colours so as to fix or make the same permanent or fast on cottons, linens, silks, mohair, worsted, and woollens, straw, chip, and Leghorn.—Sealed October 9, 1820.—(*For copy of specification, see Repertory, Vol.* 42, *second series, p.* 134.)

William Harvey, of Belper, Derbyshire, Rope Maker, for certain improvements in the manufacture of ropes and belts by machinery, and also for improvements in the said machinery.—Sealed October 12, 1820.—(*For copy of specification, see Repertory, Vol.* 40, *second series, p.* 257.)

LIST OF NEW PATENTS.

John Hearle, of Devonport, in the County of Devon, Engineer, for certain improvements on engine-pumps applicable to ships and every other purpose that a pump can be applied to.—Sealed November 3, 1834.—(*Six months.*)

Joseph Gibbs, of Kennington, in the County of Surrey, Engineer, for certain improvements in carriages, and in wheels for carriages.—Sealed November 4, 1834.—(*Six months.*)

Samuel Bagshaw, of the Parish of Saint James, in the County of Middlesex, for an improved filter for water or other liquids.—Sealed November 6, 1834.—(*Six months.*)

Peter Rothwell Jackson, of Bolton-le-Moors, in the County of Lancaster, Engineer, for certain improvements in hydraulic presses and pumps.—Sealed November 6, 1834.—(*Six months.*)

James Walton, of Sowerby Bridge, in the County of York, Cloth Dresser and Finisher, for certain improvements in the machinery used for raising the pile of woollen and other cloths.—Sealed November 12, 1834.—(*Six months.*)

Jean Michel Cramer, of Leicester Square, in the County of Middlesex, Mechanic, for an improved steam-engine.—Sealed November 13, 1834.—(*Six months.*)

Lemuel Wellman Wright, of Sloane Terrace, Chelsea, in the County of Middlesex, Engineer, for certain improvements in machinery or apparatus for making paper. Partly communicated by a foreigner residing abroad.—Sealed November 15, 1834.—(*Six months.*)

Charles de Bergue, of Clapham, in the County of Surrey, Engineer, for certain improvements in machinery for spinning or twisting cotton, flax, silk, and other fibrous substances.—Sealed November 15, 1834.—(*Six months.*)

Edward Galley Giles, of Lincoln's Inn Fields, in the County of Middlesex, Gentleman, for certain improvements on apparatus for engraving on copper and certain other substances. Communicated by a foreigner residing abroad.—Sealed November 15, 1834.—(*Six months.*)

Samuel Garner, of Lombard Street, in the City of London, Gentleman, for an improvement in the art of multiplying certain drawings and engravings or impressions. Communicated by a foreigner residing abroad.—Sealed November 15, 1834.—(*Six months.*)

William Crofts, of New Radford, in the County of Nottingham, Machine Maker, for certain improvements in certain machinery for making figured or ornamented bobbin-net or what is commonly called ornamented

bobbin-net lace. — Sealed November 20, 1834. — (*Six months.*)

William Wells, of Salford, in the County of Lancaster, Machine Maker, and George Scholefield, of the same place, Mechanical Draftsman, for an improved apparatus or machine for cutting the pile or cords of fustians and other fabrics manufactured of cotton, wool, and other fibrous materials.—Sealed November 20, 1834.—(*Six months.*)

Robert Whiteside, of Air, in the County of Air, Wine Merchant, for certain improvements in the wheels of steam-carriages, and in the machinery for propelling the same, also applicable to other purposes.—Sealed November 20, 1834.—(*Six months.*)

Alexander Craig, of Edinburgh, for improvements in steam engines. Communicated by a foreigner residing abroad.—Sealed November 26.—(*Six months.*)

James Lutton, of Tudor Place, Tottenham Court Road, in the County of Middlesex, Chair Maker, for certain improvements on castors for furniture. — Sealed November 25, 1834.—(*Six months.*)

Robert Joseph Barlow, of Rudley, in the North Riding of Yorkshire, for certain improvements in springs applicable to carriages and other purposes. — Sealed November 25, 1834.—(*Six months.*)

James Couch, of Stoke, Devonport, Captain in the Royal Navy, for certain improvements in ship's channels. —Sealed November 25, 1834.—(*Six months.*)

Jacob Tilton Slade, of Carburton Street, Fitzroy Square, in the County of Middlesex, Gentleman, for an improved metallic sheathing for the bottoms of ships and vessels.—Sealed November 25, 1834.—(*Six months.*)

John Donkin, of Blue Anchor Road, Bermondsey, in the County of Surrey, Civil Engineer, for certain improvements in the machinery for making of paper. Communicated by a foreigner residing abroad.—Sealed November 25, 1834.—(*Six months.*)

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TO

VOL. II.—NEW SERIES.

J. S. Hodson, Printer, Cross Street, Hatton Garden.